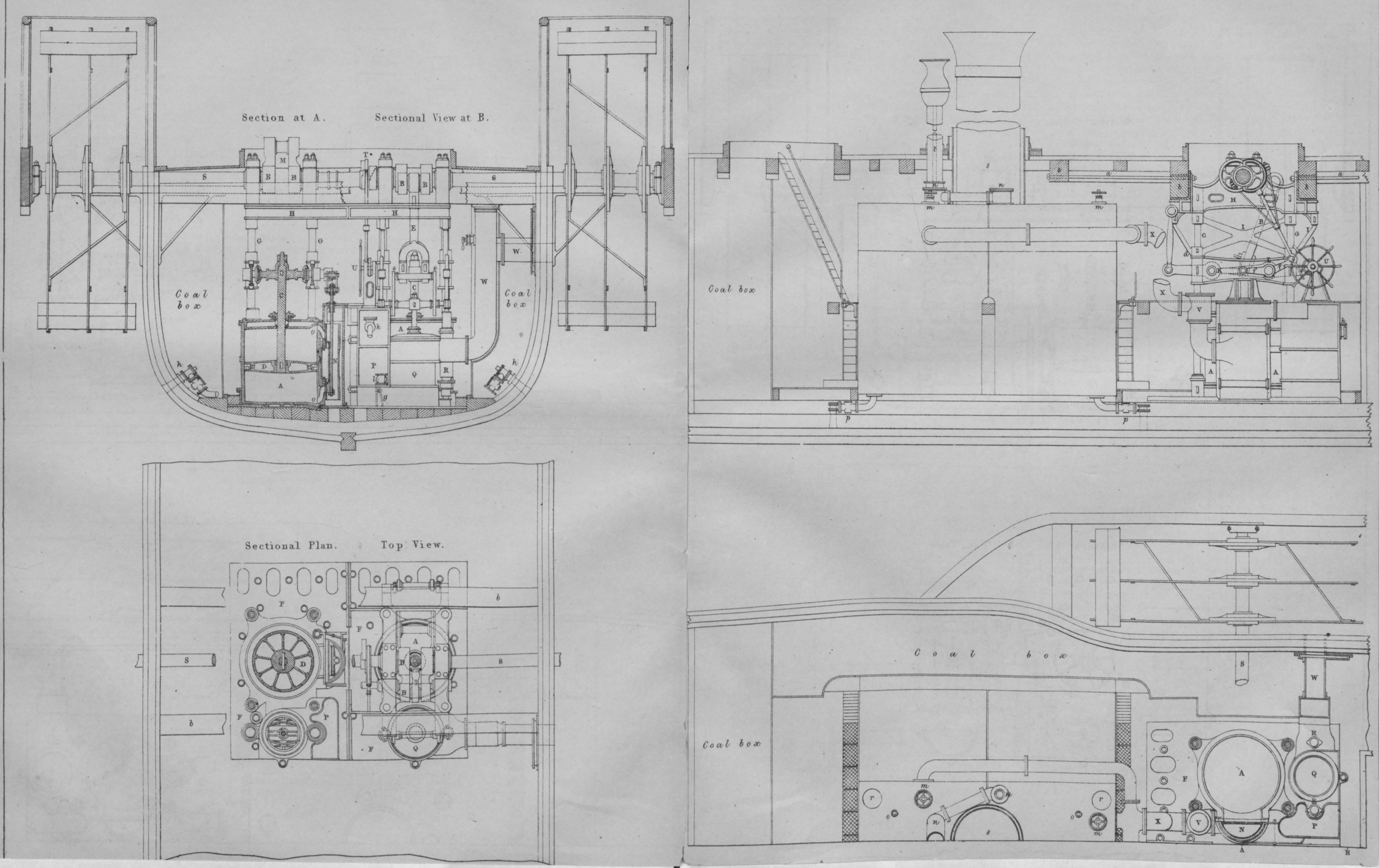
Engines of H.M. STEAM SHIP VULTURE of 476 H. POWER, By WILLIAM FAIRBAIRN & Co. Mill Wall, London.



ENGINES OF H. M. STEAM SHIP "VULTURE."

By Wm. Fairbairn & Co., Millwall Works, London.

(With two Engravings, Plates II and III.)

The general arrangement of these engines will be apparent, from an inspection of the accompanying engravings. Their chief peculiarity consists in the arrangement of the parallel motion, and the manner in which it is made available for working the air-pump. The four main parts of each engine, viz., the cylinder, slide valves, condenser, and air-pump, form a square, and thus occupy the least possible area. With a speed of 220 feet per minute, and an effective pressure of 7 lb. on the square inch, according to the regulation of the Admiralty engineer officers, the power will be 238 horses for each engine, or 476 horses collectively. The space occupied by the engines is 12 feet 3 inches fore and aft, and 19 feet athwartships, and the total length of the engine room is 52 feet 8 inches, with boilers calculated for the full power of the engines; and 59 feet 8 inches, with stowage for 440 tons of coal.

The leading dimensions and proportions are as follow—the letters refer to the engravings.

A, Cylinder, 80⅝ in. diameter.

B, Crank, 2 ft. 10½ in. from centre to centre.
Length of stroke, 5 ft. 9 in.

C, Piston Rod, 8¼ in. diameter.

D, Piston, with metallic packing rings, and steel springs.

E, Connecting Rod, 8 ft. 7½ in. long, 10 in. diameter at middle, and 9 in. diameter at ends.

F, F, Base plate, cast in two parts, one for each engine, and firmly joined in the middle. It projects equally on both sides of the crank shaft, and takes hold of the ship for the length of 17 ft. 6 in.

G, G, Wrought Iron Columns, 7 in. diameter, keyed into sockets on the base plate, and rising through sockets cast on the cylinder, to carry the entablature. The sockets on the cylinder are bored out to fit the columns, but allowed to rise or fall with the elongation or contraction of the cylinder.

H, H, Entablature, supported by the wrought iron columns G, G. It is attached by bolts *a a*, to the engine beams *b b*, and these bolts run through to the main paddle-beams *c c*; diagonal trussing being introduced between these beams.

I, I, Wrought iron cross stays, with the sockets *d d* forged in one piece. These sockets are bored out to fit the columns which pass through them, and are fastened with a cotter.

K, Wrought iron stays.

L, Shaft, fixed in a boss on the wrought iron stays K, and on which the beams *e e* vibrate to work the air-pump, these beams being at the same time the radius rods of the parallel motion of the piston rod. On the outer and projecting end of this shaft, the lever *f f* for working the valves also vibrates.

M, Crank Pin, 11 in. diameter.

N, N, Slide Valves, 14 in. length of travel; $8\frac{9}{16}$ in. breadth of space.

O, O, Cylinder Ports, 40 in. long by 5⅝ in. broad, and ⅝ in. open to the steam when the engine is on the centre; they are opened equally for the ascending and descending strokes, as the engine is balanced by other means.

P, Condenser, cubic contents 103 ft; *g*, foot valve, *h h*, injection pipes with Kingston's valves, *k*, sea injection cock, *t*, bilge injection cock.

Q, Air Pump, 45 in. diameter.
Ditto length of stroke 2 ft. 10½ in.
Air pump rod, cased with brass, 5¾ in. diameter.

R, Feed and Bilge Pumps.

S, Paddle shaft, 15¾ in. diameter of necks.

T, Eccentric.

U, Starting gear, power as 15 to 1.

V, Equilibrium Expansion Valve; *i*, cam for working expansion valve.

W, Waste water pipe and delivery pipe.

X, Steam pipe to each cylinder 17½ in. bore.
Paddle wheels 26 ft. 6 in. diameter to extremity of floats.
Ditto, floats 8 ft. 9 in. long. Each float in two parts, and each part 13 in. broad.
Boilers four in number placed back to back, 23 ft. 2 in. total length, 26 ft. 10 in. total breadth, and 13 ft. high.

m, m, Shut off valves for steam, to connect or disconnect the boilers.

n, n, Safety valves, one on each boiler, with levers in the engine room to ease off the weights.

o, o. Vacuum or reverse valves.

p, p, Blow off cocks, one to each boiler, with Kingston's valves.

r, r, Man-holes to boilers.

s, Chimney, 5 ft. 10 in. diameter, and 44 feet high above steam-chest, with double external casing.

t, Waste steam pipe, 17 in. bore, with internal pipe for condensed water.

A CHAPTER ON CHURCH-BUILDING.

Being Comments on some Opinions thereon recently published.

By George Godwin, F.R.S., &c.

The Anglican church for some years past, if it may be said without apparent want of respect, has neglected her duties. Zeal was wanting on the part of her ministers, and luke-warmness, if nothing worse, was the result on the part of the congregations. To remedy this evil, many good and learned men have lately worked sedulously, and have succeeded in raising a very different feeling from that which existed before on the subject. Whether, as is often the case after a violent re-action, an evil of an opposite character may be caused—whether the freshly excited zeal has not, or may not, outrun discretion, it would not become the writer to inquire in this place: his business is simply with one result of the present state of opinion.

With greater attention to the rites and ceremonies of religion, has come, very properly, greater regard for the buildings in which they are celebrated. The text, "Is it time for you, O ye, to dwell in your cieled houses, and this house lie waste?" has been powerfully commented on in numerous places, and has been put forth in various shapes; while at both our Universities, as well as in many other quarters, societies have been established, whereof the clergy are the chief supporters, for the improvement of church architecture, and for the preservation, and the proper restoration, of ancient models. This has led to a corresponding increase of attention to the subject, on the part of the professors of the art; the principles of pointed architecture (the ecclesiastical architecture of our forefathers), have been investigated, and much sounder views have been arrived at than were before general: so that not to mention what has been already done, we may anticipate, without fear of disappointment, an important improvement in every new church that may hereafter be erected.

One of the points dwelt on at considerable length by recent ecclesiological writers, is, the *symbolism* of church architecture, the fact that every ancient ecclesiastical building was intended to convey numerous sacred truths by its form and arrangement,—and the consequent deduction that *ritualism* should be carefully studied by all those who may be called on to design churches.

A general outline of their views in this respect, regarding a church as deduced from ancient buildings remaining to us, may be thus stated. A chancel and a nave are the essential parts of a church; the latter is the representative of the church militant, the former of the church triumphant. The chancel-arch, which defines and separates the two (and is never to be omitted) images the close of our life. The entrance to the sacred structure should be at, or as close to, the west-end as possible, and the font must be placed near it, typical of our entry to the church militant by baptism.

When ailes can be added to the nave, the edifice becomes more perfect, as, apart from the increased accommodation, the three parallel divisions so formed, serve in continuation of the symbolical system, to set forth the Holy Trinity, to which numerous other references are ever found, in the windows and tracery of ancient ecclesiastical buildings. In a cruciform church, the best form, but to be adopted only when funds are plentiful, the four arches at the junction of the nave, chancel, and transept, symbolise that by the writings of the four Evangelists, the doctrine of the cross is taught to the four quarters of the world. Further, on the altar are to appear two candles, to signify that "Christ is a light to lighten the Gentiles, and the glory of his people Israel."

Now, that it is wise and proper to enforce this system so strongly and so constantly as has been done—to render matters of this description all-important—we should be quite unwilling to assert. We would give all "the aid which slackening piety requires;" we would not

> " ———— conceal the precious cross
> Like men ashamed: the sun with his first smile,
> Shall greet that symbol crowning the low pile;
> And the fresh air of incense-breathing morn,
> Shall wooingly embrace it; and green moss
> Creep round its arms thro' centuries unborn."

We would place

> " Our Christian altar faithful to the east,
> Whence the tall window drinks the morning rays;"

We would most worthily adorn the house of God, to render it to the extent of our means fitting for its high purpose—but at the same time we would carefully avoid all proceedings, however agreeable to our temperament, however enticing to us as an artist, which should give undue importance to bricks and stones, and man's inventions and devices, which should increase the number of ceremonial observances, which should threaten to exalt the shadow in the place of the substance, and so lead to a state of things which did once result from such a course, and may result again, notwithstanding the increased amount of information possessed, and the general comparative enlightenment.

Relative to the size of the chancel, the Cambridge writers say, it "should not be less than a third, or more than the half, of the whole length of the church. The larger it is made within the prescribed bounds, the more magnificent will be the appearance of the building."[1] Into this portion of the structure, none but those engaged in the ceremonies are to enter; and here the whole of the service is to be performed with the exception of the sermon. The north side of the chancel-arch is pointed out as the best position for the pulpit. It seems to us, and we say it with the greatest deference, that a deep chancel, such as is here insisted on, however magnificent and striking it may, and does, make a building, is unsuited to the Protestant service as it has been *heretofore* performed. The fact is evident in an examination of the arrangements made in the majority of our cathedrals, wherein, if the service were read in the chancel, so to term it, and the worshippers were confined to the nave, nothing said by the priest at the altar could possibly be heard by them. In ordinary sized parish churches too, if the chancel were one-third the length of the building, and still less if half, the majority of priests would fail to make themselves heard, unless indeed the altar were placed at the west-end of it, with a reredos or screen, to rail off the remainder of the chancel. The use of the rood-screen, still further to separate the laity from the clergy, which is strongly insisted on, would throw an additional impediment in the way. *If it be not necessary* that the service should be heard and understood, and into this inquiry we will not venture to go, then of coruse the objection vanishes. The very occurrence of this question in the mind, however, serves to explain why the architectural works to which we have referred, are termed by some, "engines of polemical theology."

Writers of the Roman Catholic faith insist on the inconsistency of the position held by Protestant divines, who urge this and other opinions relative to the form, arrangement, and decoration of our churches. "The good men who are so earnestly labouring for the revival of Catholic church architecture," says the *Dublin Review*,[2] must be convinced that we must have the Catholic service revived, in the first place, before any real good can possibly be accomplished." This last necessity, (Catholic meaning here *Roman* Catholic,) we deny altogether. The principles of ancient church architecture, as applied to suit one set of circumstances, being studied and understood, may be adapted without difficulty to other, and in this case but slightly modified, circumstances, and made to produce as efficient a result. The remark, however, may possibly be deemed to apply in some degree to those who would bring back all such forms and details as were anciently used, although altogether unsuited to present requirements.

The antiquity alone, of a practice or form (strong as it makes its claim), would hardly seem sufficient authority in all cases for its revival: thus, (to illustrate our meaning from a different source,) the certainty that the practice of burying in churches is of very ancient date, and its consonance with our feelings, are now not deemed by the majority sufficient reasons for its continuance, the injurious tendency of the custom being fully known.

According to recent writers, nothing is to be done that has not been done before. Fearing the ignorance of modern architectural professors, (a little too imperiously stated, be it remarked, by some of the non-professional writers,) the necessity of having a precedent for every tower, and door, and window, and moulding, is insisted on. Design nothing, copy all, is the deduction which forcibly presents itself. "Inspice et fac secundum exemplar quod tibi monstratum est." This course has safety to recommend it, but will hardly effect for posterity, what our forefathers have done for us.

To rid our churches of close pews and lumbering galleries, and to destroy the opinion, that to accommodate the greatest number of people at the smallest possible cost, is the chief problem to be solved in church building, would be a great achievement. Something has already been done towards this very desirable end, and the work is progressing. The fact once thoroughly understood, that more worshippers may be seated by means of open benches than in pews, will in this utilitarian age, operate more powerfully in leading to their disuse, than any of the other numerous arguments against them which have been advanced. So far as appearance is concerned, there cannot be two opinions on the subject.

As an artist and an enthusiastic, though humble, advocate of the fine arts, the writer cannot regard the present views on church decoration, but with gratification, seeing in them the promise of a noble field for their exercise and development. Less than seventy years ago, Sir Joshua Reynolds, West, Barry, Dance, Cipriani, and Angelica Kauffman, offered munificently to adorn the interior of St. Paul's Cathedral with paintings, with the view of convincing the public of the improvement in our sacred buildings, which might be effected by this means, and so of obtaining an opening for the encouragement of British art. The then Archbishop of Canterbury and the Bishop of London, however, could not be induced to entertain the proposition, on the ground that it savoured of Popery, and the idea was in consequence abandoned. How doubtful of one's own judgment should such marked changes in opinion make us—how tolerant of the sentiments of others should we be, remembering as all must, the different light in which we ourselves have viewed the same circumstances at different epochs, and the alteration which is constantly taking place in our own views and opinions.

In one of the latest publications of the Cambridge Camden Society, containing many very excellent suggestions,[3] it is remarked, "a church is not as it should be till every window is filled with stained glass, till every inch of floor is covered with encaustic tiles, till there is a rood-screen (?) glowing with the brightest tints and with gold; nay, if we would arrive at perfection, the roof and walls must be painted and frescoed." In carrying out such views it is hardly necessary to say, the greatest care must be taken to prevent a theatrical effect likely to result from such a course, unless pursued with great judgment. We

[1] "A few words to Church Builders," 2nd Edition. Published by "Cambridge Camden Society," 1842.

[2] February, 1842.

[3] "Church Enlargement and Church Arrangement."

are disposed to think a more moderate use of colours than has been made in recent restorations in London and Paris, might produce a result equally excellent in an artistical, and more so in a devotional, point of view. Scripture sentences upon the walls, "ywritten full thicke," are amongst the most excellent and fitting adornments of a church.

The increased use made of stained glass in England is exceedingly gratifying, and the excellent specimens which have been prepared lately show clearly, as the writer has on many other occasions asserted, that we could produce stained glass quite equal to anything that was done by our forefathers if proper encouragement were afforded to the professors of the art. Difficult of attainment, expensive in its processes, so much so, indeed, as almost to prevent experimentalizing except for actual commissions, and labouring under the weight of an erroneous opinion that the art was lost, glass-painting had remained for a long time in a very languishing condition. Latterly, however, it has revived considerably, and many large works in various parts of the country are now in progress. The opinion entertained of our want of skill in glass-painting is hardly yet removed. The author of "A few words to Church Builders," says, "stained glass is of much importance in giving a chastened and solemn effect to a church. Those who travel on the Continent might find many opportunities of procuring from desecrated churches, at a very trifling expense, many fragments which would be superior to any we can now make. But if it be modern, let us at least imitate the designs, if we cannot attain to the richness of hues which our ancestors possessed." Against the opinion to be inferred from this, we will venture to place our feeble protest. There is much old stained glass to be found on the Continent inferior to what we can now make, and there is not a great deal which we could not equal if the proper opportunity were afforded. Moreover, we do not believe there are any hues possessed by our forefathers which could not now be produced.

Let every material employed in the construction of a church be *real*, is a wholesome injunction likely to produce excellent results, although, perhaps, some may think it could be carried too far. It has been too much the custom to endeavour to produce a showy and deceptive external appearance, without proper regard to the fitness, propriety, and excellence of all the various parts of the building, which, indeed, have been sacrificed for it. While deal painted to imitate oak, and Roman cement in lieu of stone, give entire satisfaction to ourselves, and obtain the approval of the world, no efforts will be made to obtain that which is better, and a niggardly calculating spirit is engendered, grudgingly giving the "just enough," which is unworthy of Christians, and destructive of more good feelings than one.

In *designing* buildings in the pointed style, this same doctrine cannot be too constantly reflected on. The more fully our ancient edifices are studied, the more clearly does it become apparent that nothing was introduced unnecessarily or deceptively for mere appearance sake—that the excellence of effect, which is apparent, resulted from the use of sound principles, laid down not with the view of producing that effect, but with reference to stability, convenience, and fitness; good taste and great skill being afterwards employed in adorning that which was necessary, and making the Useful a producer of the Beautiful. Plans were not made to accord with a fanciful elevation, entailing thereby loss of convenience, and unnecessary outlay, but were arranged first, to suit the requirements of the time, and upon these naturally the elevation followed. All decoration grew out of the construction, and reason governed instead of caprice. This is now better understood than it was a few years ago, and will doubtless produce its fruit in due season.

The virtual abrogation of the regulation, at one time enforced by the "Incorporated Society for Building Churches," that no timber roof should be used without a tie beam, will do much to restore to modern churches one of the most striking features of ancient buildings—the open arched roof—and is a subject for congratulation. The same may be said of the feeling now fortunately growing, against the tasteless tombs and monumental slabs with which our noble cathedrals and churches have been gradually encumbered and overladen. Like some frightful fungus, they have spread insidiously over all parts of these structures, destroying alike their beauty, propriety, and stability. Our metropolitan Abbey presents a lamentable example of the evil; and it is to be hoped that the acknowledged good taste of those who now govern there, will not merely prevent the increase of this abomination, but lead, as opportunities may from time to time offer themselves, to the removal of the excrescences now deforming that fine building, and to a restoration of its harmonious proportions and original integrity.

To say that every one of our ancient buildings should be most religiously preserved, is perhaps, less necessary now than it was some little time ago; still it cannot be repeated too often, for alas! instances of injury and destruction still occur, and not unfrequently. Full of information, abundant of association, and suggestive of most wholesome thoughts, they are contemporary histories, which once lost, can never be replaced; and in which every alteration even, or interpolation, is an offence against society. They are the visible links which make the past and the present one; they are the standing monuments of the Christian religion, and attest at one and the same time our forefathers' piety and our forefathers' skill.

THE NEW ROYAL EXCHANGE.

INSTEAD of being at all premature, some of the remarks we are about to make come too late to be of the service they otherwise might—that is, supposing suggestions so thrown out to be ever attended to, which may fairly be questioned; for although architects are apt to be not a little sensitive when their productions are animadverted upon, they rarely seem disposed to screen themselves from criticism by attending to, and profiting by, what it has objected to, either in their own works or those of others. It is probable, therefore, that our observations will be of just as much service now, as they would have been if brought forward when they could have been acted upon, at least fully taken into consideration before it had been determined to pursue an opposite course. But with regard to consideration, none at all, as far as we can ascertain, appears to have been given to what was one of the most essential points to be deliberated upon at the very outset, viz. whether the new Exchange should be covered in or not. All we know is that, instead of its being made a question, it seems to have been settled, or rather assumed as matter of course, that it should be a mere open court, such having been the case in the former building. No idea of the possibility of any thing else appears to have occurred to any one—at least not to any one who had a voice in the matter. Yet though we say it should have been made a question for discussion, we do not think there was occasion for much discussion, the advantages of the central area being covered in instead of left open, being so many and so obvious, that merely to specify them would have been sufficient, we think, to carry the decision at once in favour of such plan. What could have been urged in behalf of the contrary mode, the one actually adopted, we cannot even conjecture; therefore, if any arguments at all were adduced in its support or justification, we should be exceedingly glad to learn what they were—which is more, we suspect, than any one can inform us. The only satisfaction then left us, until we are so informed, is the liberty of concluding that, notwithstanding all that was said at the time about the vast importance of the Royal Exchange as "a National Edifice, that should be in every respect worthy of the first commercial city in the world," and much more to the same effect; very little of careful consideration seems to have been bestowed upon it, great as was the delay, and noisy as was the squabbling as to who should be the architect.

Had a thought been given to the matter at the outset, it would probably have been perceived that, even supposing it otherwise mere matter of indifference whether the area were covered in or not, there was a golden argument to turn the scale in favour of its being covered—namely increased rental from the shops on the exterior of the building, in consequence of the greater space that could then have been given up to them, without at all interfering with the accommodation required for the body of the Exchange. According to Mr. Tite's plan, the entire space occupied by the latter will be about 19,000 square feet, but out of this number, 6500 will be quite open and unsheltered, consequently cannot always be made use of for purposes of business. Now had it been determined that the centre portion of the plan should be covered in, there would have been shelter every where, therefore the breadth of the ambulatories might have been considerably reduced, so as to afford an additional depth of nine or ten feet to the shops—some of which will now not be more than 7 feet in depth, or hardly that. Even then the actual space available at all times for business would have been the same, or rather more than will now be the case. And so far from the architectural effect being at all injured by such contraction of the space behind the columns, it would, in our opinion, be improved, and the whole would, in fact, appear to be more spacious than it is now likely to do; for the width of the cloister portion or ambulatories will now be so great, in order to provide a sufficiency of sheltered space, that while they will look low and depressed, they will occasion the open part or court to appear comparatively narrow and squeezed up; more especially as the same space looks considerably less when uncovered than when roofed in.

We have heard it urged as an objection to the Exchange being covered in, that it would be exceedingly difficult to light it from above without a very great sacrifice of architectural character. We, ourselves, however, are of a diametrically contrary opinion. Even supposing it to be covered by a mere skylight as a protection from the weather (as is the case with the cortile of the new structure at Liverpool, called the Brunswick Buildings) we do not see how that could interfere with the architectural elevations of the sides. We do not say it would be an improvement in point of appearance, but it would not be any great drawback on it. Hardly, however, should we recommend a skylight of that homely description for such a place as the Exchange; and skylights admit of being put into such a great variety of form, whether introduced so as to appear mere cofferings or panels receding little within the general surface of the ceiling; or as lanterns,—which may be ceiled above, and open only on their sides; and further admit of such great diversity of decoration, that a roof of the kind may be accommodated to any style and any design. While it is the most original, its ceiling, with three large skylights of plate glass (each consisting of two sloping planes parallel with those of the external and internal roof), is not the least happy idea in the interior of the Walhalla, and certainly magnificent enough, it consisting almost entirely of bronze and gilding.

For these fifty years at least, not a single edifice has been erected for the purpose of an Exchange for merchants either in Europe or America, but what has been covered in and protected from the weather, and now, instead of further improvement being aimed at, we are reverting to the old inconvenient plan of a mere open court, and to what, as such, will be no better than a pent-up and dismal area, except, perhaps, during a few remarkably bright days in the course of a summer. Almost might it be imagined that the "open court" had been determined upon, by the company of umbrella-makers, and by that of "undertakers" also. The city worthies seem to have either a very singular taste for uncomfortableness, or else very singular notions of convenience. No sooner had the public began to congratulate themselves on the very great advantages attending wooden pavements, than Sir Peter Laurie set about attempting not to *put them down*, but to take them all *up* again.

The architect of the Royal Exchange has, it seems, had sufficient influence with the Committee to prevail on them to have the pediment of the portico enriched with sculpture; let him then now recommend, while it may be yet time, that the "area" should be covered in above, for then it would be protected from the atmosphere and its London smoke, as well as from the weather; and as a hall it would not only appear more spacious than as an open court, but also more lightsome and cheerful—certainly would be more cleanly, because its pavement would be always dry.

As to the difference of appearance in regard to spaciousness, there can be no doubt; for what sort of effect, we ask, as to size, would Westminster Hall make without its roof. To an open cortile, in itself, there can be no objection; but, we must contend, it is preposterous to adopt it for a purpose where something more is obviously required.

CANDIDUS'S NOTE-BOOK.
FASCICULUS XLVI.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. Since Mr. Gwilt not only entertains, but professes, so great a horror of architectural critics, anonymous writers, amateurs, and "literary idlers," as it pleases him to call them who amuse themselves with architectural studies, it is to be hoped that some of them will horrify him yet more. Myself, for one, it may be presumed, am numbered by him among the most offensive of the tribe, and reckoned an incorrigible *mauvais sujet*, and mischief-maker. Nothing, however, can be more mischievous, or more completely opposed to the interests of architecture, than the doctrine he puts forth; for the drift of it is not to encourage the study of it as an art, but actually to *deter from* it. He would confine it entirely to the profession, treating with scorn the idea that any one else can acquire a competent knowledge of it, even as a fine art, or form a correct taste. In his opinion, the less the public know, or pretend to know, of it the better; and if he means better for himself and those (if there be any) of his way of thinking, he is undoubtedly right. Hitherto it has generally been made a subject of pride and congratulation, that architecture has enlisted among its most zealous votaries, persons of refined taste and liberal education, many of whom have rendered it essential services by their pen. But Mr. Gwilt views the matter in a very different light: he is for changing it altogether, and "*heretoforward*"—to make use of his own quaint expression—the whole race of Benthams, Hopes, Dallaways, Whewells, &c., are to be looked upon as mere "literary idlers," who, furnished with no more than a few purblind ideas, and crude notions, which they have picked up by chance, pretend to instruct and inform others in matters of architecture. Yet it is to such industrious "idlers," that we are indebted for the far greater part of what is known of the history of the art; very little information of that kind has been supplied by architects themselves, and what they have written at all seldom extends further than to the mere elements and dry rules of their art; what may be termed the philosophy of it, being rarely touched upon by them.

II. Instead of taking it amiss of Gwilt that he has omitted his work in his list of architectural publications, Wightwick ought to consider himself a very lucky fellow in escaping a good dressing from him, for having recommended the study of architecture as a very delightful, and also a very suitable, one, not only for "idle" gentlemen, but *proh pudor!* for "woman kind" also. He and Gwilt are the two poles of opinion; while the latter would confine the study to those whose proper *business* it is, Wightwick would have it rendered accessible to all; the one would have it kept as a well-watched *preserve*, with a due warning of "Man-traps and spring-guns" to scare away the public—the other is for breaking down all its paling and fences, and throwing it open as a *common*, where every one may stroll, and where literary *geese* are free to pick up what they can, and to hiss, without having their necks wrung off for their presumption. It is Gwilt's opinion that the less the public meddle with architecture the better; on the other hand, Wightwick's, that the more the public understand and render themselves competent judges of it, the better both for them and for the art itself, and those who practise it. Nor is it altogether unreasonable to suppose that people would take more interest in what they understood, than in what they are now ignorant of; and further, that the greater and more extended the interest taken in it by the public, all the better would it be for those whose interest of another kind it is, that, instead of a mere swinish multitude, they should have an intelligent public to deal with. As far as there is cause for complaint in that respect at all, it is not that there are so *many* "amateurs" and persons without the pale of the profession who study, or pretend to study, architecture, but that there are so *few*. Infinitely better would it be if the whole public, that is all persons of education were in a manner amateurs.

III. At last Boz has introduced a new character—one which has hitherto not been handled by either dramatist or novelist—in the person of Mr. Pecksniff, the architect. All other professions—the medical and the legal more especially, have been represented and shown up so frequently, that characters of that class are almost worn out. The wonder, therefore, is that no one should have before thought of turning to the architectural one. Whether, in entering upon this fresh track, Mr. Dickens has provided himself with a *carte du pays*, remains to be seen, for all that can be understood at present is, that Pecksniff is to be a very prominent character in the work; but it is not quite so clear if he is intended to be the representative of a class in the profession, or merely an individual who might equally well have been represented as belonging to any other. If, as he very well may do, Boz should show up the peculiar kind of charlatanry which stamps the architectural quack, and distinguishes him from all others of the duck-like genus—should he expose the arts by which men totally destitute of artistical talent and feeling for *art*, obtain credit with the public for being artists—should he disclose some of the clever tricks practised at competitions by very "respectable" people—should he indulge in some pleasant hits at the *vox et præterea nihil* pedants, who can merely talk by book and by rote, without an idea of their own—should he, among other things, exhibit Pecksniff as an architectural lecturer, gammoning his bewildered audiences with mere rhodomontade and fiction,—should he do this, Dickens will deserve our thanks, and the gratitude of the honest part of the profession. Still we have our misgivings, and suspect that Pecksniff will turn out rather an overdrawn and ill-drawn caricature, than an ably delineated character, and portraiture from real life. Of extravagant and tedious caricature there is certainly not a little, in the manner in which Pecksniff is first presented to us—blown down by the wind at his own door. Had any one else given us such a tirade of laboured nothingness, and dull attempt at grotesque pleasantry, it would at once have been pronounced intolerably childish stuff; whereas, now the critics will perhaps discover it to be very fine—one, indeed, has done so already.

IV. I entertain about the same affection for law books that Gwilt does for German architecture and German architects. Why does not a second Omar come to purge the world of them? Even a book bound in "law fashion" has to me a very odious look; it seems to have put on the uniform of that Tartuffe race of wolves in sheep's clothing, or at any rate wolves dressed up in calf's skin. Nevertheless, I have done that which a month ago I should have said was impossible; yes, I have actually been seduced into reading an article in the Law Magazine, one, certainly, that I should never have thought of looking for there, consequently might never have known of at all, had it not been put into my hands by a friend, when, to my utter astonishment, I found it contained a paper headed "*Architectural Novelties*"! It was like having a sovereign *palmed upon* one between a couple of halfpence; almost was it like my first meeting with Young's descriptions of magnificent country seats, sparkling like bright and verdant oases over the arid waste of such dreary matter as crops, and hoeing and drilling. Most truly does the poet say:

> "Full many a gem of purest ray serene,
> The dark unfathomed caves of ocean bear."

yet I doubt if the dark unfathomed caves, or bottomless pit of the law, contain anything more relating to architecture, whether in the shape of "novelties" or antiquities. There can, however, be no doubt, that a vast number of papers, of one kind or another, relating to architecture lie buried in literary journals and periodicals, foreign ones more especially. Were the best, or even some of the most interesting of them, collected and reprinted, they would form a *Reading* Architectural Library of considerable extent. It is by poking about in periodicals that we stumble upon such treasures as Edward Collow's descriptions of, and remarks on, many of the recent public buildings of Paris—things, therefore not likely to be met with by gentlemen like Gwilt, who despises periodical literature, and, though he has not ventured to say so, no doubt abhors architectural periodicals most of all. Neither are they likely to come to the notice of those who pore over the writings of the "venerable" Vitruvius, and carefully collate all the readings of different authors, in hopes of being able to catch a glimpse of the meaning of the mysterious "*Scamilli impares*." But the Law Magazine; —be it known, then, to all whom it may concern, that its article on "Architectural Novelties" gives some account of the Hall and Library about to be erected by Mr. Hardwick, in the gardens at Lincoln's Inn, at the south-west corner or south end of the terrace. The building is to be of red brick, and in the style of the older parts of Hampton Court. The Hall or Dining Room will be 120×45 and 54 feet high, and the Library 80×40 and 48 feet high; and both will have timber roofs. The remainder and longer part of the article relates to the restorations and embellishments of the Temple Church.

V. Raczynski is pleased to speak in exceedingly complimentary terms of the architecture of Edinburgh, and its recent buildings, as being in better taste than those of London; but then it is only in such safe general terms, that what he says amounts to nothing—at least to nothing more than a bare opinion to that effect, for he does not even mention a single one of the structures he pretends to admire. If the Nelson Monument was one of them, his praise is not greatly to be coveted. Speaking of that "monstrosity," the writer of the "Remarks on the Edinburgh Parthenon," tells us that "it ought to be pulled down"; nor is the same unlikely to be said of the other "Nelson Monument" in Trafalgar Square.

VI. It is provoking to find that the stupid Germans now propose to erect a public monument to Schinkel, just after Gwilt has put an extinguisher upon him. A public monument to a fellow who was no more than a mere "scene painter" in architecture! to one who was little better than an audacious heretic in the art, an insolent reformer, setting at defiance both Pope Vitruvius and Pope Palladio, and did not even abide by the authority of the Greeks themselves, but would fain be "*tampering*" with the ancient orders, like a conceited coxcomb as he was, in the hope of improving them, or at least of producing something as good, and not quite so hackneyed. A monument to Schinkel, indeed! Zounds! we will be revenged on those scurvy Germans, for we will erect a public monument to Gwilt; therefore the sooner he gives us the opportunity of doing so, the better.

PONT DU CARROUSEL, PARIS.

In the *Journal* of August, 1842, I stated that an improvement worthy of notice had been introduced in the construction of the Pont du Carrousel, at Paris, consisting in the application of wrought iron keys, so disposed as to obtain great precision in setting the segments of the tubular voussoirs, of which the arches of this bridge are composed. My intention is to explain more particularly in this paper, how far the application of these keys materially facilitated the casting of the voussoirs separately, and to show their useful effect in the construction of the arc on the piers.

The amount of contraction of cast iron, in the act of cooling in the mould in which it has been run, is variable; for although, as stated, the general average may be considered to be about $\frac{1}{100}$, this measure cannot be taken as an absolute quantity: it may be sensibly modified, by many circumstances, such as the quality of the metal, its temperature when run into the mould, and the greater or less rapidity of the cooling process. This difference is not of material importance in short pieces, but in a length of upwards of 160 feet, it may amount to some inches, and when the pieces are cast in great lengths, (or even if they are in short lengths,) and the joints are intended to bed fairly against each other, as is the case in bridges of the ordinary construction, this difference becomes a source of considerable trouble and annoyance.

It is objectionable to have to add to the length of pieces when cast, and to avoid this, the patterns are usually made full long, thereby allowing for the greatest possible contraction of the metal; so that generally speaking, a certain portion of each casting has to be removed by the chisel or otherwise, to get the pieces to their proper length. Notwithstanding these precautions, there will be occasional wasters, which may be properly or improperly patched up, or which if thrown away, give rise to extra expense and delay.

When the constructor has plenty of time at his disposal, he proceeds with still further caution, by casting the principal pieces, and having them put together; after this, the pattern of the remaining length is corrected, and sent to the foundry with the certitude, that the casting will come in pretty well; thus, by dint of precaution, delay, and expense, the work is got through to this stage, and if the mason work is prepared with the same care and precision, all will be found to come in very well; but a stone pier has been known to be a little out of its proper position, either in consequence of an error or the settling of the work upon its foundation. When this takes place, it becomes requisite to let the cast iron into the stone work on one side of the pier, and to place a thickness of metal between the pier and the cast iron on its other side. All these imperfections are only felt during the construction, they do not at all diminish the strength or interfere with the durability of the work, but generally speaking, all those who have been engaged in cast iron bridge building, will have had to exercise their ingenuity, not only to correct such evils, but at the same time to proceed in such a manner, that they may not leave an indelible trace on the face of the work. There is, therefore, no doubt but that the facility of extending, or diminishing, the chord line or the versed sine of the arch, would on many occasions be of considerable advantage.

The keys placed at each end of the segments, of the tubular voussoir, remove all the above mentioned objections, for the segments being kept rather short, the space will have to be divided amongst some 10 or 12 joints, so that three or four inches, more or less, in the total length of the arch, will only require the wrought iron keys to be made a little thicker or thinner than they were originally intended to be, and as they are not made until after the arc has been placed, no extra expense will be incurred, or time lost.

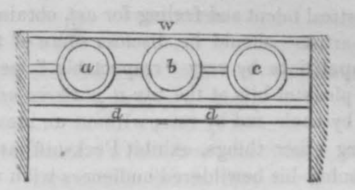
The division of the arc into so many pieces, offers another advantage, as, by reducing the weight of each separate piece, the whole can be moved about, and managed with great facility, and without requiring such powerful tackle, or such strong centering, as is generally employed. When the number of segments comprised in an arc are in their place, a wood model is made for each key, and the keys are forged and fitted in their places, without being immediately driven home; plumb bobs being suspended from the joint of the tubular rib, it becomes very easy to set the whole in a perfect line, by driving the keys on either side as may be required; and by making the keys sufficiently long, the height of the arc can be regulated with the utmost facility and precision. The keys being driven, and the whole of the tubular arc in its proper place, the bolt holes, those of one flanch having been cast in, are drilled in the opposite one, and the bolts placed and tightly screwed up, attention being paid at the same time to the plumb bobs, as the effect of screwing up the nuts may be to cause a deviation in the line of the arc, which is again easily rectified by means of the keys, and the bolts cannot otherwise affect the form of the arc.

Openings were reserved from distance to distance along the upper joint of the voussoir, for the purpose of introducing melted bitumen, which, when the bridge was finished, was done, in order to fill up the space remaining between the lamellated wooden rib, and its cast iron covering. This bitumen being intended, by setting when cool, to form a compact mass of the whole arc, with a view to increase its rigidity.

The wooden arc, as I have already said, greatly facilitated the erection of the tubular voussoir, and when standing alone, previous to the application of the latter, it had a wonderfully light and elegant appearance; but it becomes a question whether, in reality, it is at all requisite to the solidity of this kind of bridge, its flexibility being so great that it cannot in any way be expected to come to the assistance of the cast iron, which, if accidentally forced out of its original position, by any extraordinary lateral strain (the only one that could affect it) would break long before the internal wooden rib could offer any useful resistance to the strain. It also remains to be ascertained whether the wood thus confined in the tubular voussoir, will not be very subject to decay, notwithstanding every precaution that has been taken to preserve it.

The annular system of spandrils, adopted by M. Polonceau, forms another remarkable feature in this construction; they combine strength with lightness, and give an elegant appearance to the bridge. Their circular form renders them elastic; they spring under the load, so that the vibratory action, communicated to the roadway, and the upper side of the annular support, is neutralized ere it can arrive at the main rib, which, therefore, as I have already observed, maintains the most rigid firmness, under the heaviest load.

At the same time that the vibratory action is destroyed, they present also the advantage of distributing the load acting at a particular point on the road, over a considerable length of the main rib of the arch, as will be shown by the diagram.



Let us suppose three rings a, b, c, placed between a beam d, and an upper platform; and that a weight W be placed on the platform immediately over the ring b; under such circumstances the vertical diameter of the ring b, will be shortened, and its horizontal diameter will be lengthened in the same ratio; half the increased length of the horizontal diameter of b, will be taken from each of the horizontal diameters of a and c, and added to their vertical diameters, thus raising the platform immediately over the centres a and c, and by increasing its resistance, will remove a portion of the load W from the point b, to the centres a and c, thereby distributing it along the beam d.

As a proof of the advantage of this mode of construction in point of economy, it will be sufficient to mention, that although the length of this bridge between the buttresses, is nearly 500 feet, it was completed for £40,000, including every expenditure; and that, in a country where metal is very high priced. I can conscientiously affirm, that every precaution was taken, and every outlay made, that could be required to obtain good workmanship, and a solid construction. The whole of the tubular ribs were moulded in dry sand, and cast in second fusion, and the wrought iron employed is of the very best quality for the purpose.

When the bridge was finished, it became necessary, according to the government regulation, to test its strength by distributing a given load over the entire surface of the road way, the government officers in the meanwhile, minutely inspecting the work, to ascertain whether, under the strain, any defect would become apparent. This, in France, is an invariable rule adopted as a legislative measure of public security; and, until you can present a favourable report from these officers, it is impossible to obtain permission to open the bridge. We commenced by making an observation in the morning early, to determine the positive height of each arch, previous to any load having been placed on the bridge. The load (about 400 lbs. avoirdupois upon every square yard of surface) was then laid on, and in the afternoon we found that, under the load, each arch stood higher than it did in the morning without the load.

The morning (October) had been very cool, the sun coming out later in the day heated the metal, and increased its length, so that the whole difference in the height was occasioned by expansion; it became, however, requisite to ascertain if such was positively the case, and by leaving the load on the bridge, and taking an observation again when the metal was cool, we found that the arches had returned to their original position. There is nothing surprising in this circumstance, although without reflection it would appear rather paradoxical, and I mention it, not with a view of exemplifying the effect of expansion, which is of course understood, but because I consider the peculiar system on which this bridge is constructed, to be favourable to the free action of expansion and contraction, without thereby being subjected to any strain at all detrimental to its general strength.

The part of the bridge, most immediately exposed to the action of heat and cold, and more particularly to the action of the sun, is the arc itself, the upper part of the spandrils being protected by the projection of the platform, consequently large castings would be subject to unequal contraction and expansion and consequent strain, which must very much weaken them, whereas, in bridges constructed upon this principle, the flexibility of the whole system is so great, that the expansion of the tubular rib, by increasing the versed sine of the arc, can lift the entire arch without subjecting any part of it to such a resistance as would tend to diminish its strength.

H. H. Edwards.

London, Feb. 20, 1843.

VARIABLE ORIFICE OF THE BLAST PIPE OF LOCOMOTIVE ENGINES.

In the February number of the *Journal*, I described a "*Self-acting Expansion Slide Valve*," and in the course of the explanation, referred to having obtained patents abroad for an apparatus, by means of which, the orifice of the blast pipe of locomotives, can be regulated by the engine driver; I will endeavour in this paper to describe the apparatus, and to point out its general utility.

The determination of the area of the orifice of the blast pipe, is of importance in the construction of locomotives; upon its proportion depends the supply of a sufficient quantity of steam for the service of the engine, and also its comparative effective pressure upon the piston. It may be made so large, or so small, as to prevent the engine from performing her allotted amount of duty; and the application of this blast of steam, may be considered (next only to the boiler itself), the most useful invention in this beautiful machine, so essential a complement thereto, that the locomotive engine would have been very imperfect without it. The possibility of its successful application having been ascertained, experience promptly indicated the extreme limits of the area of the blast, within which the engine could exert her power; but it still remains to be decided as an invariable rule, what the exact size should be within these limits, to produce the most useful effect; and you will very seldom find any two engineers who adopt the same sized blast, for engines of the same power.

When the diameter of the orifice of the blast pipe is too great, the energy of the blast will decrease, and the draught through the fire will not suffice to generate the quantity of steam required to keep up the speed of the engine; when, on the contrary, the diameter is too small, the resistance behind the piston will become so great, in consequence of the steam not being able to escape through the contracted passage, as sensibly to reduce its effective power on the piston. Within these two extreme limits (if an invariable orifice of blast is adopted) it at first sight appears, that there must be an intermediate point at which, if it could be attained, an engine would perform the greatest quantity of work, with the smallest quantity of fuel. This intermediate point, if it can be admitted to exist, is exceedingly difficult to discover, because a locomotive engine has to overcome a degree of resistance that is constantly changing, either on account of the load, the action of the wind, the state of the rails, or other causes.

In the preceding paragraph, speaking of the extreme limits of the size of blast, within which an engine may work equally well, some doubt is expressed as to whether there exists an intermediate point that might be preferable, as enabling the engine to perform more effective duty. It is probable that within a certain limit, the blast (if invariable) may be made of any intermediate size, without sensibly influencing the average effect produced, the inconvenience and advantage resulting from the change being so nicely balanced, that no sensible difference could be discovered. If such is allowed to be the case, the efficacy of the variable blast must be manifest without a trial.

In order to diminish the resistance behind the piston at the return of the stroke, the elasticity of the steam has been taken advantage of; a chamber placed at the foot of the blast pipe, by allowing the steam to expand on its escape from the cylinder, relieves the engine, and has permitted the adoption of the most contracted orifice of blast, that I have yet seen successfully employed. The greatest relief, however, has been obtained by throwing off the steam considerably before the piston arrives at the end of the stroke, thereby enabling it to expand before the return of the piston, and thus very effectually diminishing its resistance; and although by so doing a portion of the effective power of the steam is lost, it is at the same time a judicious choice between two evils, and if not adopted, the discharge of the steam from the cylinder at the moment of the return of the piston would determine a powerful resistance to its free action, and so reduce the effective power of the engine.

The contraction of the blast pipe being an inconvenience inseparable from the condition of generating a good supply of steam in the locomotive boiler, it becomes important to partially remove this inconvenience when practicable; and as the state of the fire, and the quantity of steam required, are frequently varying, it may be positively assumed that an invariable contraction of the blast pipe is an imperfection, and that even supposing the question as to the best possible dimension were decided, and a generally admitted rule laid down, it would only then be really perfect for some particular load, and state of the fire; and that with a different load, or state of the fire, the determined orifice of the blast would be objectionable; therefore, it may be concluded that the faculty of regulating the contraction of the blast, so as to have full power over the production of steam, must be in itself a desirable condition, and that if by the same means, the average resistance behind the piston can be diminished, the "ensemble" may be admitted to be a material improvement.

It frequently occurs that there is either too much, or not enough steam in the boiler; when there is too much, it is the usual custom to open partially, and sometimes entirely, the fire door, so that by admitting a current of cold air into the fire box, and through the tubes the production of steam will be diminished; but this remedy is very objectionable, and should be applied as seldom as possible, because the rush of cold air may give rise immediately, or subsequently, to leakage in the hoops, and must very much contribute to the destruction of the tubes, and to injure the boiler itself; whereas, if it were possible to enlarge the orifice of the blast pipe on such occasions, the fire would be damped, and the steam would fall, probably without having to open the fire door at all.

When there is not enough steam, the draught through the fire, in consequence of the low pressure of the steam, and the slow motion of the engine, will necessarily be less energetic than it ought to be, the means of exciting the fire becoming inefficient at the time when its assistance is most wanted. A good engineer will certainly take care that this occurs as seldom as possible, but there are accidental causes over which he has not sufficient controul, and on such occasions the power of contracting the orifice of the blast pipe would be very beneficial, by enabling him materially to increase the rapidity with which the fire would be brought up to its proper state.

When a heavy train is going up a steep incline, its speed will decrease; the strokes of the engine being less frequent, the draught through the fire will also diminish in intensity, and the quantity of steam generated may no longer be sufficient; a slight contraction of the orifice of the blast pipe would then increase the power of the blast, the action of the fire, the production of steam, and the speed of the engine.

The engine driver generally manages his engine and fire, in such a manner, as to obtain a full supply of steam previous to his arrival at the foot of the incline; with the assistance of the variable blast, he would naturally (having plenty of steam) enlarge the orifice of the blast pipe, and thus by diminishing the resistance behind the piston, would increase the power of the engine, so that although going up the incline, she might still maintain sufficient speed to keep up the steam, notwithstanding the enlarged orifice of the blast pipe.

When running down an incline, the orifice of the blast pipe being opened to its greatest extent, the draught will be considerably diminished, because at the same time the regulator will be partially shut; the steam may in this way be very effectually kept down, although the incline may be many miles in length: and by contracting the orifice towards the approach of the foot of the incline, steam may be again obtained, without having had to expend steam from the boiler, to increase the draught through the fire, thus effecting an economy in the consumption of fuel.

By good management, the engineer can therefore have full power over the production of steam, so as at all times to have a good supply, and to prevent almost entirely the loss occasioned by its escape from the safety valves while the engine is in motion; and taking into consideration the frequent occasions on which advantage may be derived by varying the orifice of the blast pipe, it may be inferred that it is as requisite to have full command of this orifice, as it is, to be able to determine the position of the regulator. The speed of the engine may, moreover, be occasionally regulated with advantage, by varying the orifice of the blast pipe, without altering the position of the steam regulator.

To carry out, in a practical manner, the variable contraction of this orifice, it is requisite

That the apparatus should be easily constructed and applied, and not liable to get out of order;

That its action should be simple and effective;

That an indicator should show the area of the orifice under which the engine is working.

Having pointed out the general advantages I propose to derive from the application of a variable blast, I will now describe the apparatus that has been employed, which will be clearly understood, with the assistance of the annexed figures.

In the construction of this variable blast, there is one point on which it is proper here to make a remark, which if not attended to, would materially tend to destroy the good effect to be produced.

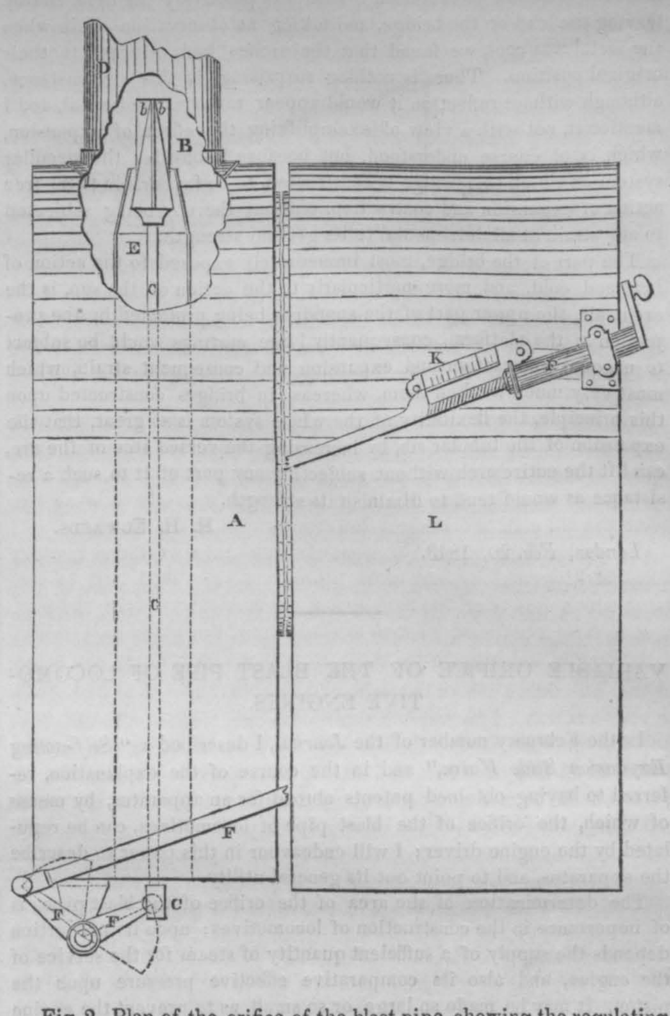
The annular space between the internal cone and the orifice of the blast pipe, if too much contracted, diminishes the energy of the blast; so that it is necessary that, at the point of greatest contraction, with a view to obtain the strongest draught, the relative diameter should be so calculated as to leave nearly a half of an inch of space, for the passage of the steam between the internal moveable cone and the edge of the blast pipe.

The intensity of the draught through the fire can be weakened, therefore, either by enlarging or by contracting the orifice of the blast pipe, beyond a certain limit. I have occasionally regulated the motion of an engine by the contraction of the blast pipe, leaving at the same time the regulator wide open, because by contracting the orifice more or less, the pressure behind the piston may be varied, and so regulated as to augment or diminish the effective action of the steam on the piston. The adoption of this variable blast may also be considered as an extra security, for by keeping the internal regulating cone of the blast pipe closed, while an engine is required to remain stationary, no danger could arise from the accidental opening of the regulator.

EXPLANATION OF THE FIGURES.

Fig. 1. Longitudinal elevation of a Locomotive Boiler, part of the smoke box being removed to show the extremity of the blast pipe. The circular portion of the boiler between A and L is omitted.

Fig. 1.



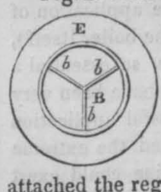
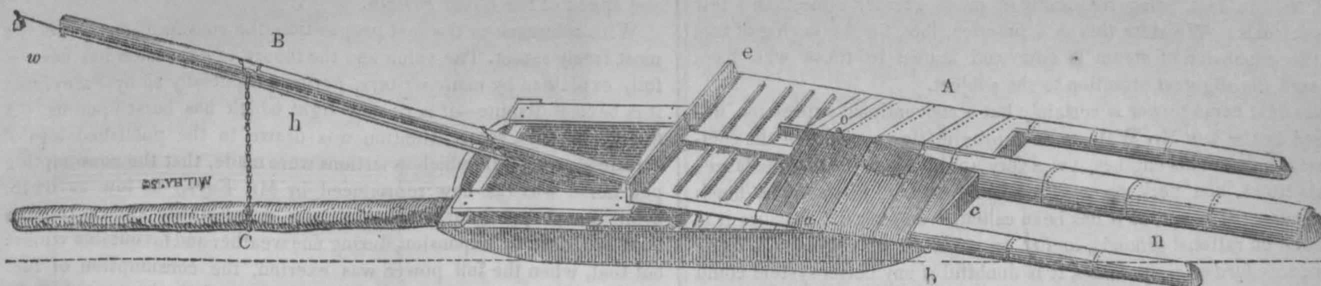


Fig. 2. Plan of the orifice of the blast pipe, showing the regulating internal cone B, with its three guide ribs *b, b, b,* upon an enlarged scale; A, smoke box; B, regulating cone of the variable blast; *b, b, b,* three thin ribs or feathers, attached to the regulating cone B, for the purpose of keeping the cone B exactly in the centre of the blast pipe; C, vertical rod, to which is attached the regulating cone; D, part of the chimney; E, blast pipe; F, hand gear to work the cone B; K, graduated plate fixed to the fire box, to show the position of the cone B, and the exact area of the orifice of the blast pipe; L, fire box.

London, Feb. 11th, 1843. H. H. EDWARDS.

THE TOMB OF NAPOLEON.—The following details are given by one of the journals respecting the tomb in honour of Napoleon at the Invalides:—In the lower part of the equestrian statue of the Emperor, which is to be erected in the court-yard, a door will be opened to a long gallery leading under the dome of the building. This gallery, paved with marble in all its length, is to be divided into three sections—in the first of which will be placed bronze alto-relievos, representing the military deeds of the republic of the emperor. The second, which exists already, and is consecrated to the interment of the governors of the Invalides, is to be enlarged, and the tombs at each side will be fenced off with bronze railing. The third section will be also adorned with alto-relievos in bronze, recording the most notable acts of the empire not military. Under the dome will be placed the tomb of the Emperor made of Corsican granite. On it will be engraved, in letters of gold, the single word—NAPOLEON.

BALLARD'S ICE BOAT.



The above engraving is an isometrical view, drawn to a scale of eight feet to the inch, of the ice boat, for which Mr. S. Ballard, had the honour of receiving of the Institution of Civil Engineers a *Telford* medal.

This boat was first used in the year 1837, on the Hereford and Gloucester Canal, and has been in operation, whenever required, ever since. It breaks the ice by *ploughing* or *forcing it upwards*, and does not require more than one-fourth of the power necessary to break the ice on the old plan of forcing it downwards against the water.

The ice-breaking frame A consists of three pieces of timber marked *n*, fastened together by two cross pieces *c* and *e*. That part of the frame which lies over the boat is boarded or planked over; one part so as to form a platform for men to stand upon, the other part raised in the middle and cased with sheet iron, that the ice may not lodge on it. The frame lies on the front of the boat, which is sloped down as shown at *a b*. The frame is made with deal timber; the two outside pieces each 27 ft. 6 inches long by 9 in. by 8½ in. the middle timber 31 ft. long by 12 in. by 7 in. These timbers are rounded on the top as far as they project over the front of the boat, and the under sides are made narrower than the top sides.

The boat is decked over from *a* to *b*, and when the ice is very strong, she has a temporary boarding over, of inch board, as far as the centre. The spar B, which projects over the stern of the boat, has the large end chained down to the middle of the boat.

The piece of timber C is attached to the spar B by a chain. It is about one ton in weight, and prevents the boat rising behind when the ice presses upon the frame on the front of the boat. It floats on the water and the chain is strained in proportion to the thickness of the ice. The timber is also chained to the stem of the boat. By these means the slope or inclination of the ice-breaking frame is kept always the same, with the advantage of a short boat, which is easily steered and managed.

The pole or shaft *h* is for the purpose of steering the boat. It is attached to the end of the spar by a chain, and is balanced by a weight *w*, so that its weight may be trifling in the hands of the steerer who walks on the towing-path.

The boat, and also the upper sides of the ice-breaking frame are cased with sheet iron. The hauling line is attached to the chain *o*.

When the ice-breaking apparatus is not required, it may be taken off, and the boat used for other purposes.

THE GREAT BRITAIN STEAM SHIP.

It was but lately that our attention was drawn to an article, published in the *Nautical Magazine* for January last, written by Mr. J. S. Enys, entitled "Remarks on Nominal Horse-power," and which is evidently a critique on an article of ours published in the *Journal*, Vol. V. p. 357, on "The Great Britain Steam Ship," the same having been copied into the *Nautical Magazine* of last November.

The object of Mr. Enys's paper is to shew the fallacy of calculations made on nominal horse-power, in fact power calculated by the rules of the late Mr. Watt, in as much as modern practice has deviated from our great master in the amount of boiler pressures, from 2½ and 3 lb., to 5, 6, 7, 8, and sometimes 10 lb. per square inch, and then proceeds to prove that the consumption of fuel by the Great Britain will be just one-half or one-third (according to the expansion) of that computed by ourselves.—He states much that is true, and something that is erroneous, and we consider, that he is guilty of omission; inasmuch, that he does not follow out his argument (he is undoubtedly able) and demonstrate what diminution of speed would result on the employment of expansion, especially to so great an extent as *one-half* and two-thirds of the stroke.

We must do ourselves the justice to say, and we are sure our readers will agree with us, that our observations were temperate, written, not in a feeling of opposition, but merely to elucidate and draw attention to what we considered errors in practice. How far we are correct in our views with reference to the case of the *Great Britain* (late *Mammoth*) time and experience only will show, we are fully content to abide by the issue.

It will be seen on reference, that we expressly guarded ourselves against any misunderstanding with respect to the character of our data, and took the trouble to explain that we were indebted for them to Mr. Hill, a writer in the 996th Number of the *Mechanics' Magazine*, so that our deductions are dependent on the accuracy of the matter there given. It does not, however, appear that Mr. Enys disputes any portion excepting the correct delineation of the boiler details, so that we were right in taking the cylinder at 83 inches diameter, 6 feet stroke, and 19 strokes per minute. In our article we entered into a calculation, founded on the capacity of the cylinders and length of stroke (commonly called *nominal* horse-power, the only data at that time at our disposal), to prove that the consumption of coals, would, during a passage from Bristol to New York, be much greater than is supposed, or than they have allowed space for in the vessel. We are met by the scientific calculations of Mr. Enys, proving that by *expansion* to one half, or two-thirds of the stroke, the consumption of coal would be considerably reduced, in a much larger ratio than the power. It is, however, worthy of remark, that, although ourselves and Mr. Enys take different methods of computing power, that we agree in the amount of fuel which would be expended, supposing the engines to work to their full power, namely 129 to 130 tons per diem.

We have again carefully looked through Mr. Hill's paper, which confirms our impression that he did not state any *distinct rate of expansion* at which the engines were to be worked, he explains the construction of the expansion valves, which are not new; and as most modern engines of large powers are fitted with similar contrivances, we concluded that in this, as in other cases, the evaporative power of the boilers and strength of the materials were calculated to supply steam for, and to resist the action of, the full powers of the cylinders, expanding the steam only by the common sliding valve, *though refinements of the special expanding valves being reserved as in other ships, for the occurrence of fine weather and fair winds.*

Our justification on this head will be complete, when we state, that "The Great Western," Cunard's vessels, the "British Queen" and "President," were each fitted with separate expanding apparatus, but that their boilers are capable of generating a full supply of steam for an expansion of not more than $\frac{3}{14}$th of the stroke—that is by the sliding valve, and it would be a matter of curious enquiry to see how frequently this is departed from. If our views be correct on this point, the general object of commanders of steam vessels, is to make the best of their way to their port without reference to the saving of fuel, *time*, in fact, being frequently of much greater value than a few tons of coals. We state this as a practical fact, for the saving of fuel by the expansion of steam is now well known to those who have devoted the slightest attention to the subject.

Nominal horse power is certainly but a conventional expression, designed by the late Mr. Watt, as an approximative measure of the commercial value of his engines, it was very applicable to the circumstances of his times, and perhaps, *until something better is produced*, as much so to ours. It is not, as it has been called, "empirical," because it is founded on rational grounds, *and if we could get all engineers to agree to one standard of computation*, it is doubtful if any better system could be introduced—it is a mechanical test from which no engineer can escape, and we are enabled, with the aid of the indicator, to apportion to its work just as much merit as it possesses; by its use we immediately discover the principles on which the engine is constructed, the rate of expansion, the state of the vacuum, the proportions and setting of the sliding valves, and other detail absolutely necessary to the good performance of an engine—in fact, we can distinguish between a good and a bad engine, between science and pretension—and in conjunction with data relative to the consumption of fuel can precisely compute the value of each man's work.

We say it will be difficult to produce anything better than this. The commercial world is satisfied, because they may be supposed to know more of a two foot rule, and its applicability to measure the diameter and length of a cylinder, than they can possibly be of the ratio, or of the rarefaction of water when converted into steam, or of the more intricate theory of expansion. No, the commercial man will continue to buy his steam engines by the capacity of their cylinders, and with the aid of his coal merchant's account, *and the amount of work done*, will come to a pretty fair conclusion, as to which engineer is most deserving of his confidence.

These observations have particular reference to marine engines, in which it is well known that *space occupied* and *weight* is of paramount importance, and it has been the aim of much consideration and reflection to obtain these, with the exertion of the greatest power at a minimum expence. We call this the *ne plus ultra* of marine engineering.

We may, therefore, doubt the judgement of the engineers of the *Great Britain*, who are using cylinders equal to 1200 horses, and by expansion, reducing the same to 700 horses, occupying both the weight and space of the former power; but perhaps we are again in fault, now reasoning on the *assumption* of Mr. Enys, as in the former paper on that of Mr. Hill.

Mr. Enys observes. "that nominal horse power is a most inaccurate basis for calculations of this nature," that is, the consumption of coal and speed of the *Great Britain*.

With reference to the first proposition, the consumption of fuel, we most freely assent. The value and the theory of expansion has been so fully explained by many writers, perhaps especially so by Farey, that it is beyond dispute—it is no new light which has burst upon us. A few years since, some attention was drawn to the published logs of certain steamers, in which assertions were made, that the consumption per horse was (as now reproduced by Mr. Enys,) as low as 6½ lb. nominal H. P. per hour, and which was satisfactorily shewn to have been produced by expansion, during fine weather and favourable winds; but that, when the full power was exerted, the consumption of fuel reached from nine to 10 lb., the general result of the best machinery, so will it be with the *Great Britain*. If, as we had supposed, from the lucubrations of Mr. Hill, that her engines are designed, *when necessary*, to work to their full power, and by *full* power we mean expansion by the sliding valve alone, and exciting an average pressure on the piston of at least 14 lb. per square inch, exclusive of the friction, then will our computation of consumption at 10 lb. per horse be found correct; that is, supposing the engines and boilers, scientifically and practically constructed; but if any credit is to be attached to the delineations of Mr. Hill, we must be allowed to doubt if even this point of economy will be attained.

If it be intended to work these engines at a *permanent rate of expansion beyond that of the ordinary sliding valve*, a corresponding saving will accrue in the exact proportion of the length of the stroke worked by the dense steam; or, in other words, the quantity of steam used or admitted into the cylinder, before the communication with the boiler is cut off. If the stroke be six feet, and the steam shut off at three feet, the consumption of fuel will be reduced $\frac{1}{2}$ (we speak practically), if at $\frac{1}{3}$ of the stroke, it will be $\frac{2}{3}$, and so on. The reduction of the power will be in a much less ratio; and from all we have gathered from a considerable experience, the velocities of the ship will be, as the cube roots of the reduced powers. These, then, are the advantages of expansion.

In order to bring this question more fully before our readers, we have made the following calculation relative to the engines and boilers of the *Great Britain*, and which will at a glance show what will be the consumption of fuel per horse per hour—the power exerted—the cubic feet of steam per horse per minute—the cubic feet of water to be evaporated per horse per hour—and, though last the most important, what we conceive will be the volocity of the ship, with full steam pressure, and with expansion from $\frac{1}{6}$ to $\frac{2}{3}$ of the stroke, giving the results for every *six inches*—from 12 inches to 54 inches, or $\frac{2}{3}$ of the stroke.

Engines 88 inch cylinder; 6.0 stroke; 228 feet per minute: 294 horse power each.

Expansion in inches of the stroke	12	18	24	30	36	42	48	54
Horse Power with dense steam	245	220·5	196·0	171·44	147·	122·	98·0	73·5
Horse Power during expansion	44·59	61·96	79·38	91·00	101·87	117·18	107·7	101·87
Total power, whole stroke	289·59	282·46	275·38	262·44	248·87	229·68	205·7	175·37
Total power with 4 cylinders, as *Great Britain*	1158·3	1129·8	1101·5	1049·7	995·5	918·72	882·8	701·48
Contents of cylinder at this expansion	211·15	190·	167·	147·8	126·7	105·6	84·5	63·4
Cubic feet of steam 2½ lb. above the atmosphere per horse per minute	27·6	25·5	23·5	21·5	19·5	17·5	15·8	13·7
Cubic feet of steam at the atmospheric pressure per horse per minute	32·5	30·1	27·75	25·4	23·0	20·6	18·7	16·2
Water, per horse per *hour*, to be evaporated	1·14	1·09	·98	·912	·840	·726	·66	·571
Coals per horse per hour, at 8 lb. per horse	9·0	8·51	7·74	7·12	6·55	5·87	5·15	4·5
Tons per 24 hours	111·5	103	92	80	70	58	45·5	34·
Speed of vessel with paddle wheels	13·9	13·8	13·7	13·5	13·25	12·9	12·4	11·7
Speed of vessel with screw	11·6	11·50	11·40	11·25	11·1	10·75	10·3	9·85

This table corroborates Mr. Eny's general reasoning, but we differ in detail arising from different estimations of the *full* power, and we would suggest to Mr. E., that he is obviously incorrect in assuming the "evaporation of a cubic foot of water to be equal to one-horse power," because that depends entirely on the rate of expansion used in any particular engine.

We may remark that we have constructed the foregoing table on the plan laid down by Mr Farey, the truth of which we have *practically* proved by indicator experiments—presuming that low pressure steam at 3½ to 4 lb. is to be used, we have supposed its density in the cylinder to be about 2½ lb. on the square inch, and have reduced this to atmospheric density for the calculations relating to the consumption of fuel.

We have been more liberal than Mr. Enys, and have allowed that *good boilers* can evaporate 8 lb. of salt water with 1 lb. of coal; that is, if they are kept in a fair state, by blowing off, or by the use of the brine-pump. This is no *supposition* on our part; it is a practical fact well known to most marine engineers.

The result given by us is also a minimum, inasmuch as we have only considered the *exact* quantities of steam required, and have not made allowance either for condensation, or for the waste at top and bottom of the cylinders, preferring that our readers should estimate this according to their own views, as far as our experience goes, we believe the allowance ought to be about $\frac{1}{20}$ of the whole quantity.

But has Mr. Enys any reason to conclude that these engines are to be worked expansively (we of course assume that he is not in any way connected with the undertaking)? We think not; and that such is not the intention of the engineers. We have noticed that she is fitted with ordinary sliding valves, arranged (with a lap of $2\frac{1}{2}$ inches, and stroke of 14 inches) to cut off the steam at $\frac{5}{6}$ of the stroke, we suspect that the separate expanding apparatus is to be used in fine weather, as in most steamers of large class; and it will be observed that Mr. R. Hill expressly states that the cranks are placed in opposite directions, and not at right angles (p. 254); and, further, the construction of the boiler is proof that the engines are occasionally intended to exert their full power, say an average pressure on the piston of 14lb. per square inch.

We are inclined to be thus particular with reference to this point, because our professional knowledge has been questioned, in having made the statement that the grate surface is "less than half the proper quantity." We are, however, hardy enough to reiterate this assertion; and further to say (if any dependence is to be placed on the drawings), that a more unscientific or badly arranged boiler could not be devised. We have made a careful analysis of its properties, and it bears out our views that it is constructed (by the amount of its absorbent surface) to supply steam for the full power of the engines, at which the consumption of coals will be fully equal to our original computation, namely, 129 tons per day. It is as follows:

Fire surface of the six boilers	=	2220 square feet.
Flue surface do.	=	11870 do.
Total surface		14,090

If the total surface be divided by the total horse power, we shall have $14090 \div 1176 = 12$ square feet per horse, and the grate surface 2 feet $\times\ 6 \times 24, = 288, \div\ 1176 = \cdot245$ of a square foot per horse!

We have no disposition to cavil about words, but think we may call the practice of our first engineers *proper*, but certainly not *usual*, in as much that in this very case there is an exception to the rule, and a straining after novelties at the expence of that which is useful. We here find that we have more than the *proper* quantity of absorbent surface, and less than one half the grate surface, and the result will be a very indifferent ratio of evaporation, as will be discovered when it is too late.

The size of the air-pump must of course be large enough to suit the extreme power of the cylinders, and cannot be adapted to various grades of expansion. With respect to the large condensers, theory taught us the doctrine as that propounded by Mr. Enys—the larger the better; but, from actual observations and practice, we find it is not correct, and that Mr. Watt was right in constructing his condensers of the same capacity as his air-pump. The proportion of Mr. Watt for his air-pump is about a sixth of his cylinder contents; and it is reasonable and just, the steam rushing from the cylinder, is condensed in detail, and the air-pump, at *one stroke*, clears the condenser of whatever vapour may remain. In the *Great Britain* this vapour *will accumulate* in the condenser; being between 7 and 8 times larger than the pump, which has no power to clear it; the condenser becomes hot, and no extreme quantity of injection water will keep it cool. We may or may not be correct in our view of this matter, but practice supports it, as our readers will see by reference to our last December number, page 399, vol. V., in which we have detailed the proportions used by some of our most eminent engineers.

We have little more to say regarding the probable speed of the *Great Britain*. We believe the factor 1400 to be applicable, having found it correct in very large vessels; and we see nothing in the construction of the *Great Britain* to render it inapplicable; presuming that the resistance (in all cases of similar form, as it regards the sharpness of the water lines) is very nearly as the areas of the immersed midship sections; lengthened experience and experiments with a great number of vessels have proved this. In this case our data is meagre, and we have no desire to carry the subject further, especially as it is probable that an actual trial of the *Great Britain* will soon settle all the questions in dispute.

We close with the remark, that however we dissent from the views of her engineers in matters of detail, we most sincerely hope that we may be found false prophets, and that the *Great Britain* will prove to be superior, if possible, to her sister vessel the *Great Western*, and that the proprietors will have every reason to be proud of their speculation.

THEORY OF ARTESIAN WELLS.

A French pamphlet, from which the following translation is made, has excited considerable interest in France, and is, up to this time, in constant requisition by the numerous visitors to the scene of M. Mulot's labours at Grenelle. Our readers, however, will have the goodness to observe, that although we present it to their notice, partly on account of the notoriety which the author's views have obtained in France and partly because it is important to consider ingenious arguments on both sides of a question like this, at the same time we feel bound to dissent almost entirely from the author's explanation.

If the ingenious and eloquent Parisian had been favoured by previous acquaintance with the phenomena of springs as exhibited in the extensive mining operations of this country, it is probable that his surprise would not have been so mightily excited by the Artesian fountain at Grenelle, and he might possibly have entertained a different and more generally received opinion as to its origin.

A GRAND EXPERIMENT; OR THE WELL AT THE ABATTOIRS OF GRENELLE.

CHAPTER I.

Exposition of the Subject; false attempts at Explanation.

This work which has discovered to the city of Paris the source of an abundant supply of water, has been not more remarkable for the boldness of the conception which gave rise to it, than for the perseverance with which the design has been followed out. In the bosom of the capital M. Mulot has opened a sort of aqueous mine, rich and magnificent; and for this great boon the Parisians are unanimous in their expressions of admiration and gratitude. The sight of the ascending stream rushing upwards from so great a depth beneath the surface has daily attracted crowds of visitors. After the first gratification of their curiosity, the attention of this multitude is naturally directed to the cause of so extraordinary a phenomenon, and the desire for information on the subject corresponds with the admiration it excites. Each successive visitor asks himself, or inquires of those around him, whence *can* proceed so impetuous a stream? what force impels it? what immense reservoir feeds it? in what part of the earth is deposited this fruitful supply, and by what passages and communications does it find access to the extremity of the vertical tube which M. Mulot has forced into the bowels of the earth? The scientific men of the present generation have endeavoured to answer these questions. Referring to the very simple means which human ingenuity has long since employed for embellishing our gardens and public places with jets of water, they have said,—At a certain distance from Paris, and in the upper stratifications of a soil more elevated than Paris itself, there exist vast reservoirs fed by the infiltration of rain water and of melted snow. This water there sinks to great depths below the surface, and, flowing in subterranean sheets, the augur of the engineer discovers it at a spot far distant from where the earth first received it, and after he has thus succeeded in boring down to it, the liquid element naturally ascends to the surface through the vertical issue which he prepares for it. This is then a real *jet d'eau*. Nature has placed the first, that is, the descending branch; the engineer places the second, the ascending branch; the machine is perfect.

From this explanation, however, we entirely dissent, and fear not to affirm that under such circumstances water never could rise on the principle of a syphon. In order that a jet of water, whatever may be its dimensions, shall work with certainty, one condition is indispensably necessary, viz., the uninterrupted continuity of the curved tube charged with conducting it from the reservoir above to the less elevated region where the jet is required to play. All the force of ascension in the second branch of this tube ought to be derived from the accelerated velocity of the water in the first branch, and this acceleration would be as inevitably broken and annihilated by any obstacle, as by the entire destruction of the continuity. Now, in the interior of the earth, to whatever depth we may penetrate, we can find nothing resembling continuous tubes; everything there is more or less friable, casual, and irregular. Thus, whatever pains the engineer may take in order to reach by the smaller end of his vertical tube the surface of a subterranean sheet of water, it will all be useless unless by a very astonishing fortuitous accident, he should meet with another tube of the same calibre, ascending without rupture to the upper reservoir. If, as some believe, it be in the mountains of Burgundy that this reservoir is placed, is it possible to conceive the existence of a continued oblique tube ascending from beneath Paris to the neighbourhood of these mountains? Besides, no one appears to doubt that M. Mulot's choice of a situation for his well was perfectly arbitrary, and therefore if he had attempted to construct one upon the Place des Invalides or in any other part of the capital, he would have equally succeeded. Hence, then, it will be granted that in and around Paris it would be possible to dig an indefinite number of Artesian wells, all which would be fed by the mountains of Burgundy; and in order to explain this, we must picture to ourselves the uppermost beds or strata of earth under Paris and the surrounding country within a circle of two hundred leagues diameter, invariably woven into an inextricable net-work of which each filament is an unbroken tube. Assuredly nothing like this exists.

There are others who have sought to explain the rise of water by conceiving two concave vases, or two immense cisterns of unequal diameter, placed one within the other, the basin of Paris occupying the centre. They imagine that the margins of these vases extend from the mountains of the Vosges on the east, to Havre on the west; and from the plains of Flanders on the north, to the mountains of Burgundy on the south. They suppose that between these two vases there is a space filled with sand. The rain water which penetrates into the pores and cavities of the sandy district is retained there by the dense matter of the two vases. The water maintains the same level through the whole of the sandy space, but it does not penetrate into the basin of the higher or smaller vase. Hence it follows, that by boring vertically through the basin, the water confined in the sand will instantly rise to the height of that which exists in the circular reservoir all round it. This is certainly a very amusing geological disposition of things, but unfortunately it is supported neither by facts nor reason. A continued vase with a double bottom, more than a hundred leagues in diameter, fixed in the bosom of the earth! A vase whose inferior limits, as shown at this day by the well of Grenelle, are no less than 1690 feet deep, and into which flow all the subterranean waters from all the surrounding shores! What a gigantic disposition of things, and no less gigantic than admirable! A god must he have been who founded Paris, and cradled the capital of the world in the centre of this marvellous vase! Ridiculous idea to imagine, even if this vase exist, that it should be unbroken throughout so vast an extent. Do we not know on the contrary that the vase is cut up and divided into many irregular compartments? Throughout the prodigious extent of space which is claimed for the field of this theory, as at Tours, at Elbœuf, at St. Denis, and St. Ouen, numerous Artesian wells have already been constructed, and all these wells of many various depths are much shallower than that of Grenelle. Has each well, then, its respective vase encased in the general vase, and resting upon its own particular bed of sand? If such be the fact, we must suppose that a great number of Artesian stages exist in the general vase. But in this case, why did not the water rise at Grenelle when the augur had reached one of these elevated stages, that of the St. Ouen for example, so near to Grenelle? Does not the Artesian vase of St. Ouen extend to the abattoirs of Grenelle? If not it must be singularly circumscribed. It has nevertheless supplied for fifteen years two constant fountains, and the Artesian wells of Tours, Elbœuf, and St. Denis are equally inexhaustible. Doubtless we may construct an indefinite number of Artesian wells upon the surface of the country which surrounds Paris; indeed this experiment has been made in various places, and according to a report addressed to the Academy of Sciences, dated 15th March, 1841, we find that "many of these wells bored at the bottom of a valley, yield no water, whilst others fixed upon the side of a hill, furnish an abundant flow." What inexplicable mystery in the hypothesis of a sheet of subterranean water fed by rain, and springing up only from inferior cavities to establish a horizontal equilibrium. Again, if it be said, that the general vase, the centre of which is placed beneath Paris, receives throughout the whole circle of its sandy borders the rain water from the Vosges, from Burgundy, from Bretagne, and from La Vendée, we ask how it is that all these waters, flowing over slopes of many different inclinations, but all of them more or less steep, and always repairing to the same cavities, has not long since choked up its own passage by the sands which it must have carried along with it. The great sands in the Delta of the Nile, in the Gulf of Gascony, and in the Aigues Mortes, all teach us the inevitable results of continual deposits. And if we suppose that the two cisterns here spoken of, are formed of a substance impermeable to water, such as glass, or porcelain, or baked earth, how has it happened, that buried in the earth during many ages, they have never experienced any shock or accident which would have broken them to pieces? It is evident if any thing of this latter kind had ever occurred, that the water which had lodged in the interval between the two vases, would naturally pass through the fissures and ruptures into the cavity of the upper vase, thus destroying the internal arrangement of the hydrostatic machine, whose existence has been so gratuitously assumed. Besides, if this machine really exists under the basin of which Paris occupies the centre, if it has its circumference at Havre, at La Fleche, in Burgundy, and at the foot of the Vosges Mountains, we could not construct Artesian wells at any of these points, for throughout the whole of this circumference, the aqueous reservoir would be only at its origin and would have no vase to rise into. And yet, nobody doubts that in the neighbourhood of all these boundary districts, the Artesian well has as much chance of success as at Paris, St. Denis or Elbœuf. It is also known that the Artesian wells of Tours have succeeded, although on the south side of the basin of Paris.

By the simplest laws of physics, we shall now show how imaginary is this Artesian source of water. We are told that through immense beds of sand the water sinks from the surface of the soil into the grand subterranean cavity. But who does not know that, when obliged to sift itself through a bed of sand, however loosely disposed, water loses all motion, except a kind of slow and difficult leakage. Towards the base of our artificial sandy fountains it comes only drop by drop, and it loses in its course all the velocity due to the space it has passed through, and all the pressure due to its weight. If the spout which discharges the water should open upon a bent tube with an ascending branch, the water would not rise above the level of the space which it already occupied in the base of the fountain. This would be its whole hydrostatic power; and if the ascending tube were full of sand, it would rise something above this same level: but, in that case, the effect would be due entirely to capillary action. The most striking objection, however, still remains. During the summer, what becomes of the rain water immediately after falling. The greater part, instead of sinking into these profound depths, is evaporated and carried off through the atmosphere, and it is very seldom that either our fields or gardens, the morning succeeding a storm, show any traces of moisture more than a foot in depth. Would not the alternation of wet and dry weather cause an incessant variation in the flow of an Artesian well, seeing that this incessantly varies the supplies of our fountains and the height of our rivers? Oh, no! in spite of all this, the Artesian wells have always the same volume, and in truth, acknowledge neither summer nor winter. We shall, hereafter, explain the constancy of Artesian wells. But, in the first place, we must consider another gratuitous supposition. Let us first explode all error, we shall then more easily arrive at the truth. It is said, by some, that the rain water and that which proceeds from the melting of snow, sink into a subterranean horizontal region void of solid matter, but hemmed in above and below by two beds of impermeable clay. Upon the upper one reposes an enormous mass of chalk and other calcareous stone, which bears with all its weight upon the volume of water underneath, and this weight forces the water to rise vertically at every place where an opening is made down to it from the surface. In this hypothesis all the mechanism of ascension derives its impetus from this force of pressure. The origin of the water is a matter of indifference, it may have come from Langres, from the Vosges, or from the Jura mountains; its complete inertia is the same when it has arrived in the centre of the basin, beneath the abattoirs of Grenelle. The process of filtration, which has brought it to this place, gives it at least no inclination to ascend; it has, therefore, waited patiently to be impressed by superior masses, in the same way as the fluid, which is motionless in the body of a pump, waits only the action of the piston to force it upwards. But to produce this discharge, the piston must move—it must, in reality, press upon the water which it brings or sends up—in fact, it must work up and down in the barrel of the pump, filling at each successive point of its motion the whole area of the barrel. If we suppose that the subterranean sheets of water rise only because they are pressed by the solid masses above them, we must also suppose that these masses really *act*, as no ascension can be obtained except on this condition; that they actually *fall*, so that, in digging the well of Grenelle, there finding water 1600 feet below the surface and causing it to flow impetuously more than 80 feet above the surface, M. Mulot would have expended so much art and courage only to provoke a disastrous crash in the strata beneath Paris. Evidently, however, and very happily, we may add, this has not been the result. The laws of gravity are universally the same. Place on the surface of the earth a sheet of water of any extent; fill, for example, the basin of the Champ de Mars with a body of water which shall remain there; endeavour then to gain dominion over this sheet of tranquil water through solid masses of chalk or clay. In order that these masses shall remain in position superimposed on the stagnant water, they must be fashioned into vaults and arches, and there they will be supported without pressing upon the water of the basin. If, for a single instant, they should rest upon this water, they would inevitably sink and be submerged in it, and the result would be a chaos of *debris* saturated with water. But in the bosom of the earth no solid masses are found in the shape of vaults, neither are there any sheets of water, either confined or at liberty. It is true there are here and there, in the cavities of rocks, in subterraneous grottos, and at the foot of all great mountains, a few pools of water, or more often there are rivulets fed by the infiltration of rain water, and serving to supply fountains which rise at a short distance, and which generally contribute to the formation of streams and rivers. But nearly all these are found on the surface, none of them can occupy a space of any extent in the lower beds of the earth, because they would soon fill up such spaces, by depositing the sand which they bring with them. Besides, in any case the subterranean waters impelled only by a broken, unequal, irregular movement, would have no disposition like those of a *jet d'eau* to rise above the inclined bed over which they had flowed. A *jet d'eau* in exercise is in fact a pendulum, it is free and regular in its movements, its mechanism is the same, and the same cause produces it.

Now if a pendulum, starting from any altitude whatever, should meet in the course of its descent towards the vertical line, any obstacles which retard it, the motion will either stop at this vertical line, or at least the oscillation will be very feeble, since it will correspond to that feeble force of acceleration which the obstacle may not have entirely destroyed. In the same manner, the liquid pendulum, that is, the column of water, throughout its descent to a horizontal situation, rigorously requires, in order to an equal rise in the ascending branch, that all its motion and all its acceleration should be truly effected in a continuous canal, entirely filled by the water itself, by the water alone, and that so perfectly as to be inaccessible even to atmospheric air.

We shall now describe a simple and conclusive experiment. Upon the bottom of a basin, place an upright tube with an opening entirely through it; and on some stormy day fix the basin beneath the water pipe of a house. The tube will be found to contain some water at its lower end, but only to the height of that which is also found in the basin around it. Not a single drop will rise above this level because all the force of its fall is expended on the basin itself. But let us now replace the straight tube by one which is curved upwards from its lower extremity, and we shall find that the force of the fall, being confined to the continued column of water which must entirely fill the tube, will cause the water to rise in the ascending branch to the same height as the top of the descending branch. We have now then constructed a real *jet d'eau*, because we have made use of the only apparatus which can produce one.

It is quite certain that the crust of this earth no where contains an apparatus of this kind; the flowing of an Artesian well cannot therefore be assimilated to a *jet d'eau*. Some other explanation then must be sought, and in order to be satisfactory, it must be one which answers all the conditions of the phenomena.

The explanation we are about to give is necessarily of this kind, since it is derived from an universal principle of nature.

Chapter II.

The true explanation.

The globe which we inhabit is manifestly a focus of action and heat, which has its greatest energy at the centre of the mass, and which, from this central point, works incessantly to carry matter from the interior to every point of the surface, and which, in this constant effort, meets with a gradually increasing resistance from the successive strata composing the crust of the earth.

This exterior resistance constrains the central fire to divide and attenuate the matter of the interior, and to sift it, as it were, in minute particles through the pores of the general envelope.

From this internal elaboration, and this subtile oozing out, arises the continual emission of interior caloric, an emission which necessarily takes place in a radiating form; that is to say, each jet or steam of caloric escapes and flies off in a direction perpendicular to the surface. Here then is the first analogy with the vertical stream of water which issues from an Artesian well. Each pore in the terrestial covering is an Artesian well of caloric; and so again is each pore in the surface of every star in heaven an Artesian well of light. These Artesian pores in the crust of the earth being infinitely numerous, it is through these that the central fire impels, in a state of the most minute subdivision, a great part of its interior contents.

This way of escape, however, is not every where sufficient; the central action does not appear to succeed in attenuating every substance to such a degree as to effect its expulsion through such exquisitely minute apertures. At many places under the terrestial covering, opposing masses are crowded together, some in a state of gas, others in a vapoury state, others again in a liquid form, and others possessing the consistency of solids, but at the same time broken and confusedly mixed together; and all these substances, whether gases, vapours, liquids or solids, are agitated by a movement whose impetuosity equals its disorder.

The time is now come when the exterior resistance is suddenly conquered; the crust cracks—a *volcano* is open, and its centre shoots forth immense jets, at first of gas and vapour, then of liquid water, then of burning lava. It is a frightful pit, suddenly thrown out by the irritation of the central fire.

We know that the volcanoes of Iceland frequently vomit forth torrents of gas, vapour, and liquid water, which cannot have come from the sea, as its composition is different from that of sea water.

Let us imagine, for a moment, what would happen if at the instant when a volcano was about to burst forth, its crater could be contracted into a straight tube like that of Grenelle! What a magnificent Artesian well would then be displayed! What force and height would there be in the jet sent forth!

But let us not forget that every volcano is a kind of relief and vent for the interior tumult of the earth. It resembles the pimples and boils on the skins of men and animals. In the normal or regular state, the volcano is silent, and so in a state of health is our skin smooth and sound.

Thus, at the present time, when no terrestrial volcano is in a state of formidable eruption, the globe, like a sound and healthy man, quietly and uniformly transpires through every microscopic opening in its surface, the superabundance of its interior productions; and under their general covering these productions are chemically elaborated, so that each may occupy its proper region. The water in a state of vapour, which is directly formed in the bowels of the earth, even finds a passage through strata of the denser character. If near the surface it meets with argillaceous masses, it requires an increase of effort to traverse them. Below these the vapour thickens, condenses, and takes at length the liquid form; and then, far from being oppressed by the contact and weight of the solid masses which cover it, the water is constantly, if we may use the expression, in a state of insurrection against them, and continually seeking to rush up through them, or throw them off.

Hence it is that if human industry, exerting itself at the surface of the earth, shall pierce this surface and force down a vertical pipe into the aqueous region, the impatient water seizes upon the means of escape, and fully liquified by its very first movement in a passage so contracted, runs impetuously through its whole length. Arrived at the orifice, it flows over, and even mounts above it. The vertical jet has a force proportionate to the depth of the excavation which was necessary to arrive at the water.

This circumstance is remarkable, for the contrary would be the case if the Artesian fountain were produced like an ordinary jet d'eau, by the simple weight of a liquid column falling from an elevated reservoir, and working to regain its level. We know that in every hydraulic apparatus, the effective action is weakened in proportion to the extent of surface which the liquid has to pass over, and to the friction it has to overcome.

But not only is the force of the Artesian jet much greater in proportion to the depth of the excavation—the heat of the liquid itself shows clearly that the augur of the well sinker has more closely approached the producing and expelling fire which exists in the centre of the globe.

The source then of Artesian eruptions, is the same as that of volcanic eruptions; it is the central action of this terrestial globe; it is the formidable Power, which, during the infancy of the world, launched out upon its primitive surface alike the isolated cones and long unbroken chains of lofty mountains, and which from time to time is exerting efforts to raise new mountains. This marvellous Power is that sole and universal Force, that Expansion which is constantly in exercise throughout all material being; it is none other than the grand PRINCIPLE, the SOUL of nature, the producer of *life*, which under the eyes of all men, spreads and developes itself throughout the substance of every organized being, and whose expression and sentiment each one of us exhibits in his own person.

REVIEWS.

Walks through the Studij of the Sculptors at Rome, with a brief historical and critical sketch of Sculpture from the earliest times to the present day. BY COUNT HAWKS LE GRICE, K.S.G., Chamberlain of Honour to his Holiness the Pope, &c.

"It is with great pleasure," says the *Diario di Roma*, "that we announce this new work, by a learned Englishman; it contains descriptions of works in sculpture, executed by the most renowned living artists. And we may now congratulate ourselves in having, in this work, found a person in every respect qualified to do justice to living merit, and at the same time give a sure and instructive guide to direct attention to the modern productions of the chisel. Throughout the work, the Count displays profound erudition, and extensive knowledge of the arts, and much beauty of classical and poetic illustration. Hitherto, there existed no book to guide the inquiring traveller through these repositories of modern genius and taste; and hence numbers visited Rome, without deriving pleasure or profit from their inspection." In consequence of these remarks we were led to a perusal of the Count's work, from which it would appear that sculpture has attained, at Rome, a remarkable degree of perfection; and that many of the works of the nineteenth century are equal to those executed in the Augustan age.

The degradation of taste in the arts has ever been a mark and consequence of the degradation of taste in literature; and we shall find during the four great ages of the fine arts, that literature flourished. The first and most brilliant age was that of Phillip and Alexander the Great, or that of a Pericles, a Demosthenes, an Aristotle, a Plato, an Apelles, a Phidias, and a Praxiteles. The second age is that of Cæsar and Augustus, distinguished likewise by the names of Lucretius, Cicero, Titus Livius, Virgil, Horace, Ovid, Varro, and Vitruvius. The third age was in the time of Medicis; the most glorious age of Italy, when learning was restored under the Popes Julius II and Leo X, and when flourished a Michael Angelo, a Raphael, a Titian, a Tasso, and an Ariosto.

But it is time that the Count should speak for himself. In describing an allegorical bas-relief, the author says—

"This allegory is intended to show the difficulties which the arts have to contend with, from the ignorance or malevolence of those who can neither understand their value nor feel their influence, and whose souls are so materialised, if we may be allowed to use the expression, philologically not metaphysically, as to appreciate nothing which is not gross. For such souls, the noblest productions of the chisel and the pencil possess no attractions; the works of genius and of taste are to them as so much waste marble and canvass; and there are not wanting some, who would gladly wage a war of extermination against the productions of the chisel and the pencil. Even in Old England, my own, my native land, the land of commerce, wealth, power, freedom and science, how comparatively parsimonious is the encouragement of the fine arts, and how comparatively unknown are sound artistic principles! Far from us the ignominy of disparaging our adored country, which absence has served only to endear to us still more: but it is time that England should take her stand among the nations of civilized Europe in relation to the fine, as she does with regard to the useful, arts. It is time that a fair portion of that wealth, which is so often profusely expended on less refined enjoyments, should be appropriated to the encouragement of the liberal arts, particularly of sculpture and painting; and we should no longer bear the reproach of employing foreign artists, whilst we neglect to promote the cultivation of national artistic taste and talent."

The Count again observes—"The foreigner finds no obstruction in Rome to his progress in the fine arts; but, on the contrary, enjoys indiscriminately with the Roman, all the facilities that Rome commands. Hence, we find that Thorwaldsen and Fogelberg have abandoned the frozen regions of the north to bask in the sunshine of their fame in the more genial clime of the south. These eminent sculptors have both won laurels for their country. France, too, is not backward in the race of glory; and her splendid academy in Rome will perpetuate her series of distinguished artists. Russia, too, extends efficient patronage to her native artists; and at this moment she maintains in Rome 30 pensioned students. Naples, also, has a Royal Academy here, under the direction of Baron Camuccini, the first of living painters; and Berlin, Spain and Portugal, have also their respective academies in Rome, as have several other nations, too numerous to be mentioned. Thus does Europe testify, that Rome is in truth the only school for the fine arts. And must we make one painful exception, and that exception our own, our native land? Yes, it is our painful duty to state, and we do so, in the humble hope of drawing attention to the fact, and remedying the evil, that England, with all her wealth, sends but one solitary artist to Rome from the Royal Academy, and that once only every three years! How, then, can she compete with other countries in the true classic style of art."

In speaking of the extraordinary progress of sculpture, our author observes—"The group of Nestor and Antidochus by Alvarez, executed during Canova's life time, the Discobulos of the late Kessels, the Achilles of Albasini, and the Mercury of Thorwaldsen, astonished the whole artistic world; and yet they essentially differ in style and character from the works of the immortal Canova. These productions have aided in producing a revolution in style, which is likely to be permanent; and all with one accord now agree to follow the pure style of Grecian sculpture. Denmark has now to boast a Thorwaldsen; Sweden a Fogelberg; England a Gibson and a Hyatt; Ireland a Hogan; Scotland a Macdonald; Italy a Tenerani and a Finelli; Spain an Alvarez; and Holland a Kessals, all educated in Rome, and essentially Roman sculptors of the revised school of Grecian art."

It does appear that nation after nation and century after century have been able to do little more than copy the Grecian masters. We know the use Virgil made of Homer in his Æneid, and of Theocritus in his pastorals; and we find that Horace applied several places, out of Anacreon and other lyrics, to his own purpose: therefore, why should we preclude the modern sculptor from copying from Grecian art? "There is," says the Count, "but one school of art that can lead to perfect design and execution, and that is the school of Grecian art. Any deviation from the Grecian type must necessarily be a departure from the only true standard. The choice of a subject, the attitude, and in some instances, the drapery, are all of comparatively minor importance, provided the artist has made the severe, classic style of Grecian art his canon. The works of the greatest modern artists should not be taken as models; to copy their style would be to give a translation from that which has been already translated; and he who suffers himself to be carried away by his admiration of modern productions, should bear in mind that their authors drew their excellence from no living artist, but from the great masters of ancient Greece, whose productions they have profoundly studied. When the great Canova blazed in the zenith of his fame, many artists became imitators of his style, and their copies were mere shadows of the great original; they wanted the soul that animated his statues: and the exquisite essences, which Canova extracted from Grecian art, had evaporated in the attempt to transfer them. That the works of any eminent modern artist may be consulted with advantage we freely admit: they serve as a guide to the ascent of an eminence difficult of access; they inspire the artist with ardour; and encourage, while they urge him onward by their counsel and example. They are so many auxiliaries to the other powerful excitements to glory; and their combined influence has fired the breast of our talented countryman, and raised him to the proud eminence from which his genius (Gibson) sheds such lustre on his name and on his country."

Our author seems to have forgotten our distinguished countryman, Mr. Baily, who, says a recent writer, "is one of those instances, too frequent in the history of art, in which the rewards of genius of the highest order have been too long deferred, and too sparingly bestowed. Gifted with a sense of beauty, akin to the spirit of his great countryman Flaxman, and a boldness of conception not unworthy in some of its exhibitions, of the greatest of sculptors, Michael Angelo, he has yet been destined to see men, less highly endowed, step before him into the light of patronage, and commissions pass by his neglected studio, on their way to foreign lands." "It is not to be doubted," continues the writer, "that had Baily been found by his countrymen in the metropolis of his arts, his genius must, amid the strong lights of the everlasting city, have long ago secured for him, in spite of his English name, those triumphs which it is as little to be doubted yet await him." It appears to us that the removal of our Baily from the eternal city, is something like transplanting a rare exotic out of a warm and genial clime, to a cold and sunless country, where if it but chance to put forth its buds, a hard and a killing frost nips them ere they blossom and bear its precious fruit. Abbè du Bas, in his reflections on poetry and painting, has collected a great many observations on the influence which the air, the climate, and other such natural causes, may be supposed to have upon genius.

Before we close this interesting book, we are tempted to make one or two more extracts, which will fully prove the Count's abilities for the task he has undertaken. In describing the *Triumph of Apollo*, a bas-relief by the celebrated sculptor Thorwaldsen, the Count observes:

"This bas-relief represents Apollo attended by the Graces and by Cupids, as he conducts the Muses, eminent poets, and promoters of the fine arts to Mount Parnassus. The first figure is Hyperion, the father of Aurora; he is on the wing, bearing a torch, and is conducting the winged Pegasus. Apollo appears seated in his chariot, drawn by the horse of Helicon; his brow is wreathed with a laurel crown, and in his hands are his harp and plectrum. With impassioned air he sweeps the silver strings, which fill heaven with melody, and render the very stones harmonious. Next follow the Graces, entwined with festoons of flowers, and conducted by an infant Love, while the god of the Cyprian bowers is on the wing, and scatters roses on their decoy path. The fair daughters of Jupiter and Euphrosyne appear in unveiled loveliness, and glide along with the lightness of summer zephyrs. The first among the Muses is Calliope; presiding, as she does, over eloquence, she holds in her hand a scroll, such as Demosthenes might have thundered from as he paced with earnest step the solitary beach of his native Attica. Euterpe, as she plays her favourite lute, joins Terpsichore in the merry dance. Thalia and Melpomene follow, with the characteristic symbols of comedy and tragedy, the pedo or pastoral staff, the mushe and club. Erato, the muse of love, is crowned with roses, and attended by a winged genius with a harp, the golden strings of which he touches lightly with his dimpled fingers, and the air resounds with the soft sighs of the votaries of Erato. Polyhymnia is known by her meditative air, and presiding, as she does, over song and rhetoric, she holds in her hand a scroll. Urania is at once recognized by the globe as the Muse of Astronomy; and Clio, the Muse of history, follows, and is inscribing with a pencil of light, on the annals of Fame, the names of those whose exploits have entitled them to immortality. Mnemosyne, the mother of the Muses, follows near to Clio; she is closely draped, and moves with slow and maternal air. At a short distance from her is Homer, the father of heroic song, who is preceded by a winged genius bearing a palm branch and a wreath of flowers, emblems of his pre-eminence and renown. The venerable bard lifts his sightless eye-balls towards heaven, the source of his inspiration; and, whilst his fingers sweep the strings, his lips give utterance to those epic strains which enrapture gods and men. "Homer," says a modern writer, "transports us to a new and ever fresh creation, in which, though much is calculated to astonish, all appears real, substantial and imperishable. Olympus, with its deities on their golden seats, lies open to our view, in form as palpable as the glorious towers of Troy, the sacred Scamander, and Ida with its hundred springs. Prodigies become familiar to us!"

Such is a brief outline of the bas-relief before us, which combines so many classic beauties of such various characters, that even the *disjecta membra* delight us; but, to catch the spirit of this sublime creation, let us but cast an eye over it for a moment as a whole, and we shall thus learn to appreciate its surpassing excellence, and to estimate, as we ought, the genius of the man whose creative power invented, and whose artistic skill executed, "The Triumph of Apollo."

We will conclude our extracts with a description of the "Terrestrial and Celestial Love," a bas-relief by Gibson, R. A. "This relief is composed of two figures, one representing Terrestrial the other Celestial Love, under the forms of two winged Cupids. They are both contending for the soul, under the form of a butterfly, the emblem of the fair Pryene, who was about to be immolated on the altar of Venus. Celestial love appears in the act of descending from above; he has rescued the soul from Terrestrial Love, and is staying his hand to prevent its pollution at so foul a shrine. In the struggle, Heavenly Love has triumphed over earthly desire; and holding aloft the divine Psyche, he plumes his ethereal wings to bear her aloft to purer and brighter realms. Terrestrial Love holds the torch of Hymen, which he has lighted from the flame burning on the impure altar of Venus; and at the foot of the altar are the fatal instruments of his power, the bow and arrow, and also a pine-apple, the symbol of love.

"This bas-relief is an illustration of one of the tenets of the Platonic philosophy. Plato compared the soul to a small republic, of which the reasoning powers were placed in the head as in a citadel, guarded by the senses, and the tumultuary portion he placed in the inferior parts of the body. He was the first heathen philosopher who maintained the immortality of the soul upon solid arguments, deduced from truth and experience; and he held that the soul, being an emanation from the Divinity, can never remain satisfied with objects or pursuits unworthy of their divine original. According to Plato, supreme happiness is attainable by removing from the material and approaching nearer to the intellectual world, or, in other words, by governing the passions according to the principle of the moral law; and thus, by the practice of virtue, exalting ourselves to an imitation of the Divinity, from whom the soul has proceeded, and to whom, when its affections are thus purified, it is finally to be united in supreme felicity. The beautiful moral thus conveyed by this exquisite composition is too obvious to be dwelt upon. Who has not experienced the struggles of the sensual with the spiritual man? and who has not felt, within his breast, those lofty aspirations which lift the soul above the debasing influence of unholy desire, and fix its affections on another and better world? Nor is the idea of two Cupids struggling for the soul recommended by the simple beauty of its moral alone, but also by its classic taste, for the ancients recognised a celestial as well as a terrestial Venus. "I will not assert," said Socrates, "that there are two Venuses; but as I see that there are temples consecrated to the celestial as well as to the terrestial Venus, and that they sacrificed in the former with ceremonies more sacred and with victims more pure, I presume that two goddesses of that name do exist. The vulgar Venus inflames the passions, and the heavenly Venus invites to virtuous actions.[1]

"It were superflucus to dwell on the artistic merit of this relief; it evinces a mind cast in a classic mould, and possessing a deep and refined sense of the beautiful in conception as well as in form; nor can the harmonious lines of the composition be too much admired or too highly praised."

From our extracts we are sure our readers will agree with us, that the sculptors of Rome have good reason to congratulate themselves on having found in Count Hawks le Grice one who has not only brought their productions favourably before the public, but is very likely to perpetuate their memory. We are indebted to Pliny and Pausanias for a knowledge of some of the noblest pieces of ancient sculpture, many of which have perished; and whatever may be the fate of the works which the Count describes, he is very likely to transmit to posterity their merits, and the honoured names of their authors. We understand that the author has received numerous literary distinctions from various learned bodies; and we have no hesitation in saying, that his "Walks through the study" more than justifies the opinion held of his merits. The style is characterised by an elegant simplicity and classic purity, and the work is enriched throughout with such felicity of illustration and fecundity of invention, as shed a golden glow over its pages and the productions which they describe.

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[1] Ε'ικασαις δ'α̕ν και τους ερωτας τηνμεν Παν δημον των σωματων επεμπειν στην δ'Ουρανιαν της ψυχης τε και της φιλιας και των καλων εργων.—Συμποσιων, *Ser.ofonte in fine.*

Railways, their Uses and Management.—London, Pelham Richardson, 1842.

This is a very interesting epitome of all the railways that have been executed and in progress in this country, and is very ably written, affording a brief insight into their cost, working, and management. The following extract, relative to some of our principal engineers, will be read with some interest.

"Most happy should we be if the undertaking had to depend for its success in Parliament upon its own value without the intervention of counsel, as not only would time and money be thus saved, but the real merits of the proposed work would be brought forward more honestly, or if it had not these pretensions and that recommendation, it would lose a false bolster and fall. It is well known that the skill and science of the different Engineers is frequently useless to them, with all their assured knowledge, by their failure as witnesses. Thus George Stephenson is never put into a witness-box, if his friends can keep him out, he has not the temper for cross-examination by persons he considers ignorant of the subject, and with his opinion of himself, it would be impossible to find any person he would submit to. No man however deserves more credit than George Stephenson, for the manner he has advanced himself in the world, which is in itself no greater proof of his natural abilities, than his acknowledgment of it, is of his real unaffected excellence of heart—he is however a theorist of the wildest kind, and until he became a coal owner, felt that the first things in the world were railways and the first person George Stephenson. He has, notwithstanding his energy and knowledge of coals, failed to introduce them into public use at a reduction in their price, as he promised he would, and no inland coal will do so, however much its introduction into the metropolis may interfere with the sea-born supply. His railways are not always the best or most profitable, and we think he has made a mistake also in becoming chairman of any railway company. Robert Stephenson, with a higher education is more calm and self-possessed and makes a better witness. Walker, sharp, quick and clever, may always be relied upon for all he undertakes. Sir John Rennie, however, possessed of all the knowledge on the subject, cannot stand the badgering of counsel and forgets his professional service in his gentlemanly feelings. George Rennie is too retired and modest to make known his extensive information and much mechanical knowledge under the ordinary examination of counsel—he must be drawn out, and thus makes an honest, conscientious, and intelligent witness. Young Brunel is clever and self-possessed, and would not be easily put down. Locke's testimony would look hard, matter-of-fact, and solid—economical in all its parts. Giles is hasty, anxious, but determined not to be put down; Cubitt, quiet, calm, and firm. Vignolles, energetic and fiery, looking the very personification of some new and wild theory, to be put into immediate practice by his instrumentality, would rather astonish his audience by his bold expostulations and warm support of them, than convince by his arguments and facts, except in matters of detailed and minute expense in practical experience—his evidence has, however, been largely counted on by his employers. Braithwaite is a clever machinist, with an inquiring mind; and, in our opinion, has been spoilt by being made a railway engineer; in this latter position his only experience is the Eastern Counties line, and his declaration of the correctness of his original estimates for the whole line to Yarmouth, made at a public meeting a year and a half after obtaining the act, will hardly add to the confidence of the public in his future undertakings; his self-opinion and readiness will always support him, whether as a witness or advocate. Bidder is, perhaps, the most perfect witness; for though Rastrick has the hardest mouth of any, and the most imperturable determination not to be beaten—yet Bidder, with all the same pertinacity has, in addition, an effrontery of manner (however unintentional) which defies the most resolute opposition; Gibbs is honest and straightforward, and having bought his experience on estimates somewhat dearly on the Croydon, would never again deceive himself, or others."

Year Book of Facts. London: Tilt and Bogue. 1843.

This very useful annual abounds with a store of information extracted from numerous scientific periodicals and daily papersof the past year, and which exhibits the progress of science during that period.

A Hand Book for Plain and Ornamental Mapping and Engineering Drawing. By Benjamin P. Wilme, C.E. Part IV.

This part, like the previous numbers, contains some useful examples for reference; among others are sections of stratified rocks, titles for maps and designs, Gothic letters, &c.

NOTES ON STEAM NAVIGATION.

Slide Valves.—As the formulæ we gave on a former occasion in reference to the effect of any particular quantity of lap on slide valves, have not, we understand, been thoroughly uaderstood by the less scientific portion of our readers, it may be useful to reduce them to the form of common arithmetical rules.

To find at what part of the stroke the steam is cut off.

Rule.—Divide the cover on the steam side by half the stroke of the valve. Find by a table of *natural* sines the arc whose sine is equal to the quotient. Take the double of the arc thus found and subtract it from 90°. Find (in the same table) the sine of the remainder; add 1 to the sine thus found, and multiply the sum by half the stroke of the piston. The product will be the space travelled over by the piston before the steam is cut off.

To find at what part of the stroke the exhaustion passage is closed.

Rule.—Add the cover on the steam side to the cover on the exhausting side, and divide the sum by the length of the valve stroke. Find the arc whose sine is equal to the quotient. Take the double of this arc and subtract it from 90°. Find the sine of the remainder, add one to it, and multiply the sum by half the stroke of the piston. The product is the space passed over by the piston before the exhausting passage is closed.

To find at what part of the stroke the exhaustion passage is opened.

Rule.—Subtract the cover on the exhausting side from the cover on the steam side. Divide the remainder by half the length of the valve stroke. Find the arc whose sine is equal to the quotient. Subtract this arc from 90°, and find the sine of the remainder. Add 1 to it, and multiply by half the stroke of the piston. The product is the space passed over by the piston before the exhaustion passage opens at the opposite end of the cylinder.

All dimensions must of course be taken in the same measure, whether feet or inches. If the eccentric be so placed as to make the steam port be considerably opened at the commencement of the stroke, or so as to give a considerable lead as it is termed, the amount of the lead must be added to the cover on the steam side.

Covering boilers with bricks.—The iron platform above the boiler on which the coal generally rests, becomes quickly worn away by oxidation, and the boiler beneath it is generally much injured from the same cause, the whole top of the boiler being necessarily inaccesible, thereby imposing an insuperable obstacle to painting and even to inspection. To obviate these evils, as well as to prevent the escape of the heat, a covering of bricks set in Roman cement was some years ago applied to the boilers of the steam vessel Tagus, and has been found to accomplish its purpose effectually. Upon this covering of bricks the coals repose—the expence of an iron platform, and what is more important, the expence and inconvenience consequent upon its constant repair have thus been avoided, the shell of the boiler is preserved from corrosion, the intolerable heat of the coal boxes is obviated, and fuel saved by the conservation of the heat. The expepedient is an exceedingly economical one, and we look upon it as effectual and judicious in every respect.

We have received another letter from Greenock, signed J. G. Lawrie, respecting the formula we gave in our *Notes on Steam Navigation*, respecting the heat contained in surcharged steam, and in which our correspondent says, "I again assert, in the face of the denial in your last number, that the formula is misapplied." The best mode, perhaps, to refute the alleged misapplication, is to investigate the question by an independent method, in order to see whether the same results are obtained; and should our readers afterwards conclude that the "total misapplication" applies rather to our correspondent's correction than to our original statement, we are at least not responsible for the discourteous manner in which the intimation is conveyed.

(1) When air is heated, it expands, and the increments of volume are proportional to the increments of temperature. Every increment of 1° in temperature produces an increase in volume $\frac{1}{480}$ part of the bulk of the air at 32°. This rule has been found to apply to steam out of contact with water.—(Thomson on Heat.)

(2) The specific heat of steam out of contact with water is inversely as its specific gravity, and at 212 and saturated is ·847. From these data, the amount of advantage derivable from the use of surcharged steam may be computed.

Let t' = temperature to which the steam is raised out of contact with water.

s = mean specific heat of the steam between the temperatures 212° and t'.

v = the volume of steam at the temperature t'—the volume at 212° being 100.

x = the volume of the same weight of steam at 32°, supposing that it could be cooled to 32° without condensing.

h = heat required to raise 100 volumes of steam from 212° to t'

b = weight of water in 100 volumes af steam at 212°.

c = heat required to raise the temperature of a quantity of water $= b$ 1°.

h' = heat required to generate from water at 60° a quantity of steam equal in volume to $v - 100$.

From (1) we have $x + x \times \frac{1}{480} (212 - 32) = 100$ or (since $\frac{1}{480} = \cdot002083$) $x + x \times \cdot002083 \times 180 = 100 : \cdot x (1 + \cdot37494) = 100$ or $x = \dfrac{100}{1\cdot37494}$

From (1) also we get $v = 100 + x \times \cdot002083 (t' - 212)$ which by substituting the value of x previously found becomes $v = 100 + \dfrac{\cdot2083 (t' - 212)}{1\cdot37494}$

From (2) we find $100 : v : : \cdot847$: specific heat at the temperature t' which is therefore $\dfrac{\cdot8470}{100}$ hence

$$s = \tfrac{1}{2} \left(\frac{\cdot8470}{100} + \cdot847 \right) \text{ or by substituting the value of } v.$$

$$s = \tfrac{1}{2} (\cdot847 + \frac{001764 \ (t' - 212)}{1\cdot37494} + 847$$

$$= 847 + \frac{000882 \ (t' - 212)}{1\cdot37494}$$

But $h = (t' - 212)\, s\, c$, which by substituting the value of s becomes

$$h = \left\{ \cdot847 \ (t' - 212) + \frac{000882 \ (t' - 212)^2}{\cdot137494} \right\} c$$

Now the addition to the volume of steam produced by heating it from 212° to $t' = v - 100 = \dfrac{\cdot2083 \ (t' - 212)}{1\cdot37494}$ and the water in an equal volume, may be found by this proportion

$$100 : 6 : : \frac{\cdot2083 \ (t' - 212)}{1\cdot37494} : \frac{\cdot002083 \ (t' - 212)\, b}{1\cdot37494}$$

= weight of water in a quantity of steam, whose volume at 212 is $v - 100$. Hence, supposing the latent heat of steam to be 1000° we have

$$h = (1000 + 150)\, c \times \frac{\cdot002083 \ (t' - 212)}{1\cdot37494} = \frac{2\cdot3954 \ (t' - 212)}{1\cdot37494} c$$

Now since h = heat required to produce an additional volume of steam equal to $v - 100$ by heating the steam out of contact with water, and since h' = the heat required to make the same addition to the volume of the steam by generating it from water, it follows that the saving of heat by using the former method is $h' - h$

$$= \frac{2\cdot3954 \ (t' - 212)\, c}{1\cdot37494} - \left\{ .847 \ (t' - 212) + \frac{000882 \ (t' \ 212)^2}{1\cdot37494} \right\} c$$

which reduced $= \dfrac{1\cdot2308 \ (t' - 212) - 000882 \ (t' - 212)^2 \ c.}{1\cdot37494}$

The weight of water in steam equal in volume to v at 212° is evidently $b \dfrac{v}{100}$ consequently the heat required to generate from water steam equal in volume to v, is $b \dfrac{v}{100} \cdot \dfrac{1150 c}{b}$ which by substituting the value of b becomes $1150 \left(1 + \dfrac{\cdot00283 \ (t' - 212)}{1\cdot37494} \right) c$

And this being reduced gives the whole heat required to raise steam equal in volume to v from water

$$= \frac{1581 \cdot 181 + 2\cdot3954 \ (t' - 212)}{1.37494} c$$

consequently by this formula the heat saved is expressed in parts of the whole heat used in generating steam in the usual way

$h' - h \cdot \dfrac{1\cdot37494}{1581 \cdot 181 + 2\cdot3954 \ (t' - 212)} \cdot \dfrac{1}{c}$ by substituting this becomes

$$\frac{1\cdot2308 \ (t' - 212) - 000882 \ (t' - 212)^2}{1581 \cdot 181 \times 2\cdot3954 \ (t' - 212)}$$

If the steam be heated to 600° then $t' = 600°$, and the formula in such case gives the saving equal to about $\frac{1}{7}$th of the whole fuel used. Our former mode of determination gave the saving at $\frac{1}{6\cdot7}$, or $\frac{1}{7}$ very nearly. The minute difference arises from the specific heat having been in the one case supposed to be uniform, and in the other to vary inversely as the specific gravity.

SEWERS OF THE METROPOLIS.

To the Worshipful Her Majesty's Justices and Commissioners of Sewers for Holborn and Finsbury Divisions.

[In the last month's *Journal* we offered some observations on the construction of sewers, and reserved the examination of other portions of Mr. Donaldson's address and Mr. Chadwick's report for another occasion. Since writing those observations, we have had put into our hands a very able report drawn up by Mr. Roe, the surveyor to the Holborn and Finsbury divisions of sewers. As this report so fully enters into the subject of "flushing," we abstain from offering any remarks of our own, but leave it in the hands of Mr. Roe, whose experience on the subject, enables him to report upon it far better than we could have done had we attempted it: by a reference to the engraving of Mr. Roe's flushing apparatus, given in the last September number of the *Journal*, Mr. Roe's report will be better understood, and to all those of our professional readers who may take a deep interest in the question, we strongly recommend them to inspect the apparatus fixed in the sewer of Hatton Garden, opposite the office of the Commissioners of Sewers of the Holborn and Finsbury divisions, by an application to the Clerk of the Commissioners, we feel assured that any member of the profession will meet with the same courtesy that we did, and obtain permission to inspect the apparatus.

At the Court, held October, 1842, an order was made "that the surveyor prepare and lay before the next court, a Report as to the result of the use of flushing apparatus for cleansing sewers, with an account of the expense incurred, and probable saving to the Commission, and embracing the general improvements in drainage that have been adopted by this Commission." The surveyor, in obedience to that order, has prepared a report, which he begs respectfully to lay before you.

Several honourable Commissioners at the last court having expressed a desire that the surveyor should give as full explanation as possible of the method of flushing, and as to what effect it would have upon sewers having little or no fall in them, and upon private drains, it seems necessary to enter into some detail of the cause of flushing being suggested from the necessity that exists for using some artificial method to clear large portions of the sewers from the foul deposit that accumulates in them.

The Holborn and Finsbury divisions are peculiarly situate as having no immediate connexion with the River Thames as an outlet, the waters from these divisions having to pass through one or other of the adjoining districts of the city, the Tower Hamlets or Westminster, before reaching the river. The sewage of the Holborn and Finsbury divisions has therefore of necessity been formed to such outlets as the other districts presented for use; and these formerly being put in without a due regard to an extended drainage, the sewers of your Commission have not had the benefit of the best fall that could have been afforded to them. Of late years, the adjoining districts have lowered many of their outlets; but to alter the existing sewers of your Commission to the amended level, would require the rebuilding of about 323,766 feet of sewer, at an expense of about £200,000, exclusive of the cost of connecting sewers where the cutting would be deep, and of connecting existing surface and house drainage with them, which would make the total amount of cost nearly a quarter of a million. S ill, as the lowering of those outlets has taken place, you have availed yourselves of them to a considerable extent; witness the line of sewer to Holloway, the City Road line, the Goswell-street and Golden-lane lines, and several others, varying in length from one to four miles.

The city, some time since, sent to ask you, as data for the improvement of their sewage, the depth of sewage which it would be desirable ultimately to obtain at the junction of their district with yours;—your answer was, "the greatest depth that can be obtained." In lowering their outlets, the city have accordingly afforded the greatest depth they could; the Tower Hamlets express their intention to do the same. The covered portion of the Holborn and Finsbury divisions appears to be greater than any other district north of the Thames, the return of houses rated to the sewer rate in 1833, as made to the House of Commons, showing an excess of 723 houses above the Westminster district.

In the Holborn and Finsbury divisions there are about 98½ miles of covered sewers for house drainage, exclusive of several miles in length built by individuals, previous to the present regulations being made; there is also about 18½ miles of sewage for the surface drainage, and about 10 miles of open sewers.

In a large proportion of the covered sewers from various causes, accumulations of foul deposit obtain. These accumulations existing beneath the streets in a state of ferment for many years, were a cause of much disagreeable and unhealthy effluvia, and were a further annoyance to the public by choking up the private drains when they attained to any considerable quantity. The remedy for the evil, when complained of, was only to be had by raising the noisome substance in pails to the level of the street, and carting it away; a process which, in itself, was subject to many manifest objections, and made the breaking up of the pavement and roads, and the consequent obstruction of public thoroughfares, unavoidable.

On a general examination into the causes of deposit, one thing that arrested attention was this, viz. that in sewers of the same form and with the same fall or inclination, a different degree of accumulation was found to exist. In some instances this difference was occasioned by the common run of water being greater in quantity in one sewer than another. In other sewers the current of water coming in, where old sewers improperly met at right angles, was found to cause, at the junction of the two streams, an obstruction to the flow along the main line, and here deposit accumulated; and where the collateral sewers were connected with the main line at right angles and at different levels, the obstruction was still greater; for example, in one instance where the collateral sewer was 3 feet above the level of the main line, a deposit was formed of a foot in depth, extending in a shoal up the stream to the length of several hundred feet from the point of junction, while below that point the sewer was perfectly clear. It was also observed, that where a gully neck delivered the surface water of the street or road into the sewer through the crown of the arch, an obstruction was caused in the sewer and deposit accumulated largely on the up-stream side. The whole of these obstructions tended to lessen the capacity of the main line of sewer. The inequality of the bottom of many sewers, and the little fall in others, were causes of accumulation of deposit, and the common run of water in many sewers was found to be insufficient to carry the deposit away.

To remove accumulations from the sewers in a way less offensive than the prevalent mode, to construct the sewers on such principles as were likely to lessen the cause of the formation of deposit, became subjects of consideration. Levels were taken through the Holborn and Finsbury divisions, to ascertain the practicability and expense of remodelling the sewers and rebuilding them at the lowest level which the outlets would afford; but it was found that the level was such as would not give that fall to the sewers as would secure the passing off of the foul matter with the common run of water, and that the utmost that could be obtained would be the natural cleansing of one-half of the sewers, while the remaining portion would still require artificial aid. The cost of lowering the sewers to obtain this partial relief would be, as before stated, nearly a quarter of a million sterling.

This result the surveyor communicated to Mr. Donaldson, the chairman of the Westminster Commission, who, on examining in July 1840, the flushing apparatus now in use, agreed that it would do well for old sewers, but expressed a desire that all new sewers should have such a fall as not to need flushing.

There being a current of water of greater or less quantity in all sewers, in some constant, in others periodical, the idea presented itself of turning this ordinary current to advantage in preventing the accumulation of deposit; and to do so, the use of dams at certain distances asunder, to collect heads of water, was thought of.

A series of experiments was commenced in order to ascertain what velocity could be obtained, and how far such flushes of water would maintain velocity sufficient for the purpose required. These experiments were made with board dams fixed in the sewers, and the results led to the conviction that the deposit might be removed at less expense by this than by the prevalent method. In making experiments it was observed that the effect was the greatest when the dam was removed the quickest. Sufficient data having been acquired, the matter was laid before you, and a great number of openings were directed by the Board to be made in various sewers having different degrees of accumulation, that you might personally see the effect of the plan on an extended scale. The result proving satisfactory, you encouraged the idea, and several of your body made very valuable suggestions upon the various methods of application which were brought before you; and a report was directed to be made upon the system of flushing, and on other suggested improvements which you were pleased to adopt. In that report it was stated that the average yearly cost of cleansing was about 900*l.* per annum. To this there would in future have to be added the cost of cleansing such sewers as had not then been cleansed, but in which deposit was accumulating, and in time would need removal. An example of this class of sewers may be seen in the extensive sewage on the Whiskin estate, Clerkenwell. These sewers have been built about twenty years, and have not required cleansing until this winter. The different degrees of accumulation in these sewers show also many of the causes of accumulation where sewers are well built and have a good fall in them. For instance, the sewer in Meredith Street having a constant flow of water turned through it from St. John Street Road is kept free from deposit, whilst in the sewers in Whiskin Street, Skinner Street, Coburg Street, and the upper part of Gloster Street, the common run of water being too small to keep them clear, deposit accumulates; and in the lower part of Gloster Street, where the junction with Meredith Street was at right angles, the deposit had accumulated to nearly twice the depth that it had done in the other sewers. Of this class of sewers that would gradually come under the necessity of cleansing, there is about 97,498 feet, which, estimated at the quantity of deposit contained in the above named sewers, would, by the old method of cleansing, involve an expense of 244*l.* per annum, in addition to the sum before named.

In the Report before named, it was stated that if the average sum which the cleansing then cost was applied for seven years, and the cleansing done by flushing, the apparatus and side entrances might be fixed to the sewers without any extra charge whatever, and the public would, at the end of that period, derive the benefit of a saving of nearly 800*l.* per annum, besides securing, during those years and for the future, a saving of 300*l.* per annum in the item of cleansing, which the Commissioners had effected under their then existing contracts. The flushing system being adopted by you, the method of carrying it out was ordered to be as follows, viz. that when a sewer was complained of and required cleansing, the foul deposit should be flushed away, and apparatus fixed to enable it to be kept free from accumulations of deposit in future. The result to this time is as follows. Since the commencement of the system of flushing, the foul deposit has been washed away from about 16 miles in length of old sewers, on which have been placed 59 side entrances and 67 flushing gates. After deducting from the cost of removing this deposit by the old method, the expense of all the side entrances and flushing gates, there remains a saving of 445*l.* 13*s.* 6*d.*, and the side entrances and apparatus are furnished for future use. These sewers are about 2-7ths of those that appear to have deposit accumulate in them; and 2-7ths of the average annual cost of cleansing by the old method would be 326*l.* 17*s.* The annual cost for men to work these gates is 106*l.*, forming a saving of 220*l.* per annum on these 2-7ths of the sewers. The total cost of flushing apparatus to these 2-7ths of the length of the sewers has been 434*l.* thus whenever that apparatus should require renewing, the amount of two years' saving will renew the whole. It is not likely they will require renewing for between 30 and 40 years, if then. It is very probable that the interest of the saving will keep the apparatus renewed. There is also the saving to individuals of the cost of cleansing private drains, which, by the system of flushing, can never become choked by accumulations in the sewers as heretofore; and when it is considered that many sewers required cleansing every fifth year, the amount of expense and annoyance must have been considerable. Another benefit has been the avoidance of breaking up the pavement and roads, the cost of replacing which for holes that must have been made to cleanse the sewers that have been flushed, would have been 370*l.* The raising large quantities of foul deposit to the surface, to the annoyance of the inhabitants and passengers, has been prevented. And the side entrances and flushing where they occur have afforded facilities for the men to rake the deposit from old gullyholes into the sewers, from whence it is washed away, thus preventing the breaking up the paving round the gully-holes, and a saving in the article of cartage of the deposit. In one year and a half the saving from this cause in the amount paid for reinstating paving round the gullyholes alone has been 101*l.* 8*s.* 4*d.* A misconception appears to exist that each flushing gate requires a man to look after it; it may not therefore be irrelevant in this place to state that one man will be able to look after and manage all the flushing gates that may be placed in a district containing 15 miles of sewer.

With respect to private drains, the flushing gates are placed on such a principle that, if the whole of them were shut for twelve months together, the houses draining into the sewers would not be at all affected by the water in the sewers; but these gates are never shut except periodically to collect a head of water, and after the head is let off the gate is fastened back, so that no obstruction whatever is caused any where by the application of the system of flushing. At present, as above stated, the flushing gates are placed in such a manner that if kept shut for months together, the water would not enter the private drains; but the result of experiments made upon this point was such as induces the surveyor to state it as a matter worthy future consideration.

Several houses by the side of the open part of the River Fleet at Kentish Town, have drains from their privies emptying into the sewers; these drains were nearly filled with privy soil, which exuded and presented a most filthy spectacle along the side of the open sewer. A wooden flushing gate was constructed to pen up the water which rose gradually to such height as to completely fill the drains. The gate being very large, was made to open suddenly, by the simple principle on which the drag chain of a wagon is loosened. When the head was up the gate was opened, and the water rushed away. The effect upon the drains was, that the sudden withdrawal of the water brought out with it, the soil with which they were nearly filled, and left them in as clean a state as they were when first built. It also drew away all the soil and filth from the open sewer, as far as the head of water extended. Since the flushing gates have been fixed, particular notice has been taken what the effect is upon neighbouring districts, through which the waters of these divisions pass before they reach the Thames. The depth of the deposit was measured at every hundred feet length before using the gate; in one instance the length measured was 2440 feet before reaching the main outlet to the river. The gate was then shut, and a head 2 ft. 6 in. in height obtained, containing about 208 hogsheads of water; this head was let off, and then the whole length of sewer was again examined, when it was found that the deposit had been washed away in the whole length. In another instance the head of water was 3 ft. in height; and this was found to wash deposit away for the whole length of 3250 feet, that being the length from the gate to the main outlet. The total length of continuous sewer that a head of water at one flushing gate would serve to keep free from accumulations, has not yet been ascertained, the greatest length by experiment being 3250 feet, as just stated; but from the velocity of the current when it reached the extreme end, and the depth of water the head furnished at that point, the surveyor has not the slightest doubt but that more than a mile in length of continuous sewer might be kept clear by the use of one flushing gate.

But the washing away below the gate is not the only benefit derived from heading up water by flushing gates, for the effect which took place, in the manner named in the private drains at Kentish Town, is also beneficially felt at the heads of sewers, and in other situations. The drains from the houses in Eagle Street, Red Lion Square, enter the sewer near the bottom, so that this sewer has required cleansing as often as twice in five years, the depth of deposit being one foot and upwards; this sewer is nearly on a dead level for 300 feet. There is a flushing gate placed so as to head up water in this sewer to a height of one foot eight inches, so that when there was 11 inches of deposit, there was nine inches of water standing over the soil. The head of water was let off, and it was found that an average of 3½ inches in depth of deposit had been drawn away with the water from 300 feet of sewer by this one head.

The accumulation of deposit in this sewer is prevented by this process, which occupies a man rather less than one day in the year. The East Long Alley, and part of the Moor's Alley sewer, have bottoms of the most irregular description; the cleansing the deposit from these formerly cost on an average 16*l.* per annum: the accumulations are now kept down by a flushing gate of three feet in height, penning up the common run of water; to work which, occupies a man rather less than three days in the year.

The open sewer at the back of Glo'ster Street, Hoxton, was formerly so offensive in the summer season, that one of the inhabitants, from that cause only, petitioned for leave to arch over, at his own expense, the portion opposite his premises, which was accordingly done. But since you have placed a flushing gate in the covered sewer which empties into this open sewer, the use of that gate has not only kept down the accumulations in the covered sewer, but has had the effect of keeping the open sewer in question clear for its length of several hundred feet, thus preventing the dangerous nuisance which formerly existed. The saving in this instance is greater than that named as effected in the East Long Alley sewer.

In regard to the effects of flushing the deposit into the river Thames, the surveyor has made observations, and taken measurements, which enable him to arrive at the conclusion, that rather more than 14-15ths of the soil and impurities that entered the sewers in the Holborn and Finsbury divisions, was washed to the Thames by occasional rains, and the common run of water in the sewers.

That much road drift is swept through the gully grates into the sewers is certain. In Bedford Place, which has been lately flushed, the depth of deposit was nearly four feet; and amongst this was found a layer of road drift in one part, nine inches in thickness.

In concluding this portion of the report, it may be in general observed, that if there be running through a sewer, a sufficient body of water with sufficient velocity to prevent deposits, *that*, of course, is the best arrangement. But such an arrangement can only be obtained in main lines of sewers, unless a considerable expense be incurred in the purchase of water; and this expense would far exceed the expense of cleansing by flushing. But where there is not a run of water of sufficient body to keep the sewers clear, there is, and must be, a deposit.

A convincing proof of this appears in the sewer, in a part of Holborn, which is in the Westminster district, and which is connected with the Essex Street sewer, which has been lowered from its outfall at the Thames into Holborn, and thence along Museum Street, Bloomsbury, to the boundary of that district; to which point it was completed in 1839. Yet with the advantage of a connexion with a sewer lowered from the Thames, and at a point very little more than a mile from the river, this part of the Holborn sewer has a considerable accumulation of deposit in it.

The New River Company expressed their willingness to supply water at certain seasons at a moderate expense to your Commission, where it might be needed for flushing; but at present, the common run of water, by being penned up at intervals, has been found sufficient for the purpose. The use of flushing gates, supplies the want of a sufficient fall in the sewers, and also the want of a continuous and sufficient flow of water at a much less expense than the cost of the prevalent filthy method of clearing the sewers from accumulations of deposit.

Where there is not a sufficient fall and flow of water, then by damming up the common run of water and letting it off suddenly, an artificial fall of the water is obtained, which answers the purpose. The ordinary fall at which it is required that sewers shall be put in at, is about 5½ feet for the half mile; there are, however, cases where such a fall cannot be got: it is found at Eton, for example, that a fall cannot be got of more than two feet in half a mile, and in parts of Hamburgh not even of half that height. Under such circumstances, unless there be a large body of water, with an adequate flow, there must be a deposit. It is in such cases that the flushing apparatus, collecting the common run of water supplies a remedy. If a continuous line of sewer were formed on a dead level, and if the water be raised by a dam 5½ feet, then when the water is discharged, it has the effect of sweeping away silt, or of keeping half a mile of continuous sewer clear from deposit, producing the same effect as a fall of 5½ feet in the half mile with a continuous flow of water.

When the surveyor first suggested the present method of application to the principle of flushing, he asked your permission to take out a patent for it; but your opinion being that it should be left open for the use of any who might wish to adopt it, he did not proceed therein; as from its promising to prove a saving of considerable amount to the public at large, you as a public body did not wish a monopoly to be made of it; and in accordance with this spirit other Commissions of sewers were invited to inspect it.

Many persons, interested in sewage, have looked at the flushing apparatus used in these divisions, and the surveyor being desirous of the best possible plan, has always expressed his wish that any one would suggest anything that might answer the purpose better, but as yet he has not been favoured with any suggestion on the subject. Much approbation was expressed by many, and one surveyor of sewers considered it clever; Mr. Lindley, who is employed to lay out the new sewage for Hamburgh, expressed his high satisfaction with the plan, and at the clean state in which the sewers are kept by its use; and considered the curved junctions as an excellent engineering work: and the form of your gullies and shoots the one that should be generally used. Captain Vetch, who has been employed to lay out a plan of sewage for Leeds, suggests flushing for general use, and expresses his intention of using all the improvements you have adopted, in every place where he has any influence.

It is interesting to find that the principle of flushing has been in constant practice for 400 years at Eton College, during which long period the sewers have been kept free from accumulations of deposit by its use.[1] Sluice boards are used to keep up a head of water; these are drawn up with a windlass, but the form of flushing gates used by you is about to be adopted at Eton.

In a communication, from a gentleman, the surveyor sent to France to examine the sewers there, it is stated that there are in Paris about 90 miles in length of covered sewers, the whole of which are constantly and regularly flushed by the use of wooden dams, employing upwards of 80 persons. These flushings with wooden dams, do not, however, clear the bottoms of the sewers from a heavy black deposit which is therefore scraped together, and got by hand to the main line of sewer, where a sufficient head of water is obtained to wash it away. Now, if the method of flushing used in the Holborn and Finsbury divisions was adopted in Paris, six men would be sufficient to manage the whole of the gates; and from the very superior effect obtained by the method you use, the whole of the deposit in every sewer would be washed away without the labour at present used.

The Surrey and Kent Commission have, I am informed, used side entrances to some of their sewers for years; these were covered by a stone, but since, Mr. Ianson, one of the surveyors to that Commission, has seen the safety grating used in your divisions, he has introduced them for the use of their side entrances, and, I believe, one or both of the other surveyors to that Commission have done the same.

[1] The same principle, upon a large scale, has also been in use for many years for scouring harbours and removing bars, as may be seen at Dover, Ramsgate, &c.—Ed.

Another improvement that you have adopted, is a form of gully hole and shoot, constructed with radiated bricks, the shoot being half a brick in substance. The form of these is such as to deliver the water and deposit from the surface of the streets into the sewer, in such a direction as to cause no obstruction to the flow of water along the sewer.

There have been 690 gullyholes and 13,060 feet of shoot built after this improved manner; the saving in expense is £2149 11*s.* 9*d.*

An improved form of grate was also adopted, by the use of which there has been a saving of £422 12*s.* 6*d.* effected.

The adoption of the present method of cleansing the gullyholes, introduced in the old system, has effected a saving of £200 3*s.* 2*d.*

By the improvement in the form and construction of new sewers, a saving of £1094 6*s.* 6*d.* has been effected on 14,591 feet length of sewer. In no case has the curved form of sewer failed; nor were there any struts at all in the new sewer lately built from near Thornhill Bridge to the Model Prison; nor any left in, as none were required.

Every engineer and scientific person must agree that curved work for sewers is stronger than upright walls, where the substance of material is equal. By the use of curved work, you have been enabled to adopt a sewer for the use of short streets, by which a saving of nearly 5*s.* per foot lineal is effected from the cost of your second size sewer, which, when the great length of sewers required in situations where this sewer will suit, is considered, the item of saving will be found ultimately to reach a very considerable amount.

Of the benefit of curved junctions and proper curves to turns in sewers, it would seem needless to utter one word; and whether it be better for water conduits to have turns with curves, or turns with angles, it could scarcely be expected that there would be two opinions; and in sewers where the water is loaded with foul matter, surely the less obstruction there is to the current the better. Besides, curved junctions are in reality a saving of expense to the public, by preventing occasions of obstruction where deposit would otherwise accumulate.

To illustrate this, take the capital letter T, the head of the T to represent two sewers, the currents of water in which meet at the point where the upright portion of the T touches the head thereof, and then flow down in the direction represented by the stem or upright of the T; this seems bad enough; but a little way along the left portion of the head of the T let another line be drawn perpendicular thereto; this will represent a sewer coming in at right angles with a considerable flow of water, adding to the obstruction formed by the meeting of the other two streams, it being only six feet from that adverse junction; and the natural consequence is, that a very considerable accumulation of deposit has taken place. And if two other lines be drawn across the last perpendicular line, each of those lines will represent two sewers coming into that main line at right angles and opposite to each other, so that the water falling from the sewer or the highest level not only meets and obstructs the current of water in the main sewer, but presents an obstacle to the flow of water from its opposite neighbour, hence considerable deposit has formed in the latter; such consequences accruing from junctions at angles, entail a perpetual expense upon the public in the removal of deposit.

The above is a description of part of a new line of sewer and its junctions, built within the last seven years.

The next improvement which the surveyor has to report upon is, the adoption of side entrances to new sewers in lieu of man-holes or apertures, as formerly used. In the 24,624 feet of new sewer built by your Commission, since this improvement was adopted, side entrances, and such flushing gates as was deemed necessary, have been placed in lieu of apertures, and the saving by so doing has been £1349 11*s.* In the 21,048 ft. of sewer, petitioned for and built by individuals after the same manner, a saving to them of £782 has been effected, after allowing 25 per cent as their profit, or the amount which a builder might think he could save by doing his own work, instead of paying for it at your contract prices. The avoiding breaking up the pavement or roads, and other advantages which the use of side entrances secures, the surveyor named in his former report on this subject.

The total saving by the adoption of flushing apparatus, and of the other improvements named in this report, in about two years, is £6443 19*s.*; and 2-7ths of the sewers that require artificial aid in removing deposit are provided with side entrances and flushing apparatus for future use.

On the whole, the amount of immediate saving which it was calculated would be effected by your adoption of the improvements herein named has been exceeded; and this will be the case with the perpetual annual saving; experience showing that by flushing sewers with water, a saving of nearly two-thirds may be made from the cost of the old method of removing deposit. But the fact which is of more importance, in a sanitary point of view, than the expense of removal is, that instead of the two or three thousand tons of refuse, which may be removed for £1000 or £1200 per annum, remaining for years decomposing in the sewers, and generating miasma which penetrates the houses and creates disease there, and escapes, and is diffused in the streets amongst the passengers, the deposit would by the flushing apparatus be removed, with sufficient rapidity to prevent any extensive decomposition or any smell.

The men engaged in cleansing the sewers have a more healthy employment; the laying out of large quantities of foul accumulations on the surface of the streets, which was formerly the practice, is avoided; the pavements of the streets are undisturbed; the putting in drains surreptitiously is easily detected; private individuals are saved from the annoyance of having their drains choked, and the expense of cleansing them in consequence; and these are considerations of future expenditure in sewers, which your systematic adoption of these and other improvements will influence, so as to render your having done so one of those circumstances, the great and beneficial consequences of which will be felt, not only in these kingdoms but in every civilized nation in the earth.

In conclusion, I respectfully beg permission to make a few observations upon the address of the Chairman of the Westminster Commission, lately published and circulated, in consequence of the late sanitary report of the Poor Law Commissioners. At page 30, there is a paragraph, as follows—"The truth is evident, that the Secretary of the Poor Law Commissioners has been content to inform himself, in respect of the Metropolitan Sewage, by special deference to the opinion of one individual, whose object has been to give himself importance, by vaunting his own contrivances, by exalting his own Commission, exaggerating his own success, and with unbecoming boldness casting unjust reflections on the adjoining Commissions, traducing the competency of his brother surveyors of the surrounding jurisdictions."

In the first place, I beg to state that the first communication I had with the Secretary of the Poor Law Commissioners, on this subject, was his sending to me to give information as to sewerage, his questions being founded upon a printed copy of my report to your court, in April, 1840; the only information I gave him appears in the Report, at page 373, to part of page 378, and a quotation at page 61, on the quantity of deposit passing from the sewers to the Thames.

I never endeavoured to show the superiority of the regulations of this Commission, by comparing them with those of other Commissions; and in the few observations I made as to the methods adopted in the neighbouring districts, I endeavoured to show that improvements were in progress.

After my interview with Mr. Chadwick, I informed the surveyor of the Westminster sewers that I had been examined, and expected he would be sent for. Finding from a letter of Mr. Kelsey, the surveyor of the City sewers, that his feelings were much hurt, and that he attributed much of the Secretary's blame to me, I wrote to him, and he sent me an answer, from which the following is an extract.

"DEAR SIR,

"Did my letter to the Poor Law Secretary produce no other result than your communication, I should feel highly gratified, for it has entirely disabused my mind of an impression which is by no means confined to myself.

"With your leave, I will show your letter to a gentleman, whose father is connected with another Commission of sewers, for it is well that the ill impression should be counteracted.

"It is much to be regretted that the course which you supposed would be taken was not taken, [2] but advocates of any particular system never want to know the whole truth, but only just as much as can be bent to suit their object."

And I have been informed that Mr. Dowley, the surveyor to the Westminster Commission, never considered that anything personal to him or others was meant by me at all.

In answering the questions of the Poor Law Commissioners' Secretary, I cast no reflection or said one word on the competency of any one; and it is mere assumption to say that Mr. Chadwick has been content to inform himself, in respect to metropolitan sewerage, from me only, when the many quotations he brings from others show the contrary.

As to exalting my own Commission, it needs not my feeble praise; its own acts—the scientific knowledge of its members—the attention given to every sort of improvement, will ever produce for it that meed of praise in the public mind which is justly due. I have always been ready to give every information in my power to anyone that asks for it; but, that little is rightly known of what is doing in this Commission, or how it is done, is very evident; a fact, which the Report I this day have the honour to lay before you, will confirm.

I have the honour to remain,
Gentlemen,
Your obedient and faithful servant,

Jan. 27th, 1843. JOHN ROE.

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[2] That of other surveyors of sewers being examined.

NOTES ON EARTH WORK, EXCAVATION, CUTTING, AND FORMING EMBANKMENT UPON RAILWAYS.

Article V.—Tenders, Schedules, and Securities.

The preceding paper treated on the supervision of works during their progress; in the present one I will endeavour to give a sketch of the custom prevailing amongst the various railway works, previous to the actual commencement of works, in the prior operation of advertising the works for competition, and the condition and manner of taking securities. In the general form of contracts, plans, sections and specifications are exhibited, and printed forms of tender, drafts of contracts, and printed schedules are distributed to intending competitors; in some few cases the approximate quantities of the principal works, as earthwork and masonry are given, but the contractor has to satisfy himself both as to quantity and nature of the ground, the companies furnishing him with sections of the strata from actual borings. The directors do not bind themselves to accept the lowest tender, but reserve to themselves the power of accepting any offer which they may think fit. The successful party has to enter into a bond with two securities to the extent of 10 per cent. on the amount of contract. The amount of contract is generally exclusive of permanent way, which is let separately, as also the keeping of the works in repair for twelve months after completion. As regards the permanent way, the Company furnish the material, and the contract is taken only for laying, and perhaps including keys, wooden pins, or small wares. The keeping the roadway in repair has been tendered for by contractors at sometimes six times the amount that the actual cost has been to them. After experience has tested the amount, it has produced a feeling amongst engineers that it is not expedient to include in the contract the keeping the works in repair, but the contract to be ended on the certificate of completion being obtained from the engineer. When the directors meet to receive tenders, it is expected the parties tendering, or an authorized person on their behalf, will attend. The directors make no allowance to the unsuccessful competitors for the expense of their estimates. In some cases the bondsmen of the contractor are bound in a specific amount proportionate to the estimated amount of the contract by the engineer, not a per centage. The time of completion is in some cases stipulated, and a penalty imposed if the works be not completed within the given time, in an increasing ratio, say 100*l.* for the 1st week, 200*l.* for the 2nd week, 300*l.* for the 3rd week, and increasing by 100*l.* per week for each successive week.

The design and responsibility of centreing for bridges, &c. and the onus for the execution of the works are thrown upon the contractor, he is to repair all injuries, from whatever cause, during the execution of the work; he is not to be allowed any day bill for work "expressed or implied" by the specification, and the decision of the engineer is to be final and binding upon the contractor, in all cases where there shall be any dispute or misunderstanding regarding the specification and drawings; and should an insufficient number of men be employed, the engineer is to have full power to take the whole of the works out of the hands of the contractor, seize upon his plant, and cause the work to be finished by any other person. The payments on account are regulated by the certificate of the engineer, and a per centage retained in hand varying from 10 to 20 per cent. Some altercation amongst parties has arisen in their not being allowed to draw for material on the ground and not being in the work. The contractor is made responsible for all damage that may be done to adjoining lands, and for any penalties and forfeitures imposed by the Act of Incorporation as regards crossing canals or public highways. He, the contractor, is to furnish tools and assistants to the engineer in setting out the works, and the engineer has power to remove all materials insufficient as regards the quality at his mere dictum.

I think, as a matter of justice, that the lowest tender should have the contract, provided he obtains the stipulated securities; if the tender be not accepted, the party ought to be paid for his estimate. I consider that the present mode of taking security is unfair and inefficient, and that if penalties are to be exacted for delays, that an equivalent bonus should be given to the contractor for any number of weeks that the works may be completed before the stipulated time. I have, I believe, read attentively all the works in the English language relative to railways, and do not think that this important subject has been treated on by any party, even in the splendidly got up works of Mr. Weale, which merely give the specifications of the quality of materials and mode of execution of the works without note or comment. The practice of London for tenders of buildings under an architect is, that when a work is to be tendered for, the architect appoints a surveyor, and a limited number of contractors of note and reputation are written to, and they appoint another surveyor, who, with the former, make out a bill of quantities which is supplied to each competitor, as also the cost of the estimate, which is included in each tender, and is generally $1\frac{1}{2}$ per cent. on the amount, and which is paid by the successful party. The architect charges 5 per cent. if he superintend and carry the work into execution, and if the job fails for want of capital or change of opinion, the architect only gets paid at the rate of $2\frac{1}{2}$ per cent. on the estimated cost.

I cannot forego this opportunity of directing attention to an article in the *Companion to the British Almanac*, page 21, 1843, on the sanatary condition of the people, where Mr. Chadwick observes that "In the execution of other local works, as sewers, roads, and drains to houses, no care is at present taken to ensure the superintendence of persons of competent skill. Noisy parish brawlers obtain appointments of this nature, and are paid at an extravagant rate for inefficient services occupying only a part of their time. A case is mentioned of an illiterate person receiving a salary of 150*l.* a year, or as much as a lieutenant of engineers and a private, or as much as three serjeants of sappers and miners." Mr. Chadwick, with respect to the other works alluded to, states, a hundred thousand pounds have been received in fees for surveys of new buildings per annum, and that "this sum would be sufficient to pay the whole corps of Royal Engineers, or 240 men of science, and the whole corps of sappers and miners, or nearly 1000 trained men." Mr. Chadwick also observes that under the Tithe Commutation and Parochial Assessment Acts, that "amongst the most satisfactory surveys were those executed by a retired serjeant of sappers and miners." In respect to railways, the point of the government wedge is already introduced, and I would warn the assistant engineers to unite boldly against this attempt to interfere with them.

Whilst extracting from the *Companion to the Almanac*, I cannot forego the temptation of extending my extracts to the "Notes on railways," and the new position assumed by them in page 78, alluding to the Norwich and Yarmouth line: "the difficulty in obtaining the capital was so great, that the scheme was all but abandoned, when a new mode was devised whereby the contracts for the whole works were secured to competent parties, on condition of their investing a large portion of their contract prices in the undertaking; in this instance the contracts were taken at the original estimates of the engineer; still the principle thus adopted might obviously lead to a good deal of jobbing, and is so far to be reprehended." In the above observations I perfectly agree, and have made the extract that this *rara avis in terra* may be more fully known through the *Journal*.

Since writing the above, a special meeting of the London and Birmingham Railway Company has been held (Jan. 16), to consider the expediency of applying to Parliament for an act to make a branch railway from the main line at Blisworth to the city of Peterborough. This meeting is reported in the *Railway Times* (Jan. 21), from which I take the following conversation bearing on the subject. A proprietor asks, "Am I to understand that there is to be no specific contract for the completion of the work from end to end, and that the contract will be advertized in the usual way? I presume it will be a common contract." The chairman replies, "In one sense it will be so certainly, but I trust that in another sense it will be an uncommon one, for I hope it will be done within the amount of the estimate. We do not, however, mean to advertise, but to adopt the now usual course of writing to a certain number of first rate contractors, requesting them to send in tenders within a specified time." Proprietor.—"Then there is no actual guarantee on the part of the contractor that the engineer's estimate will not be exceeded." Chairman.—"We certainly are not now in that position, although, as I said before, the engineer's estimate was accompanied by a tender with a full guarantee for the execution of the works within the sum named." Another proprietor is replied to by the chairman, who says, "I think the honourable proprietor may fairly presume that the estimate will not be exceeded by the mode of tender now proposed. The view of the board was that there ought to be a probability of *reduction* in the terms of the tender, rather than the chance of an increase, and it was that consideration which induced us to determine on *competition*, as far as it can be done with safety. As far, therefore, as the execution of the work goes, I consider that we are in a state of perfect security, and that they will be finished within the estimate." In the above conversation we have the results of the most experienced men as capitalists and engineers that the world has produced, and with as much natural talent as perhaps ever will be produced. From which we learn that the London practice as regards contracts for buildings will be applied to railways, and that competition to too great an extent is unsafe, and that the guarantee of the contractor was for the execution within the sum named as the estimate; thereby fixing a maximum amount, and that the difficulty arose in fixing a maximum. No mention is made of a schedule, or power of making deductions by any given scale.

Another plan, letting out works, has been adopted on broken works, that is, where companies have taken works out of the hands of contractors, by allowing other parties to finish them, at a per centage on the expenditure of 7 to 10 per cent., a check being kept on the contractor by the companies in the weekly pay bills. I have also known other public works, as gas works, so carried into execution. This system is also applied to the agents of contractors and extensive commercial works, a salary being fixed, and a per centage being given on the amount of profits made by the concern.

From the number of responsibilities and restrictions laid on contractors, as previously enumerated, one would have thought there would have been no necessity for the remark, that competition had taken place to too great an extent, and was unsafe. Do contractors rely for profits on extras and unsettled amounts? there being many amounts which remain unsettled for 10 years after the completion or opening of several railways already executed, or do they rely on the law's delay? let the cause now in Chancery, of Ranger *versus* the Great Western company furnish the reply. Again, as to securities; are there no bubble companies? and on what has the contractor to rely on for letting his plant fall into their hands? I can only think his protection must be the cash in his pocket, and his being ready for active defence. I have known a poor contractor ruined, by having his works pushed in bad weather, and he was obliged to leave the works without redress. Ready money is Aladdin's lamp, and will quicken even the perception of a Lord Chancellor. In settling disputes of this nature, arbitration is sometimes resorted to by public companies, to avoid the law's delay; and engineers of eminence are called in to settle the disputed accounts. In all contracts between companies and contractors, it would be well to name two parties, all as referees, in case of dispute, to curb the sole controul of impetuous or peevish engineers.

The practice of the Board of Ordnance, is to fill up a printed schedule of prices. Take smiths work, for instance, the items enumerated most likely to be wanted, will extend to a hundred articles, of any pattern that the superintending officer may order, as, articles of wrought iron, materials for daywork or for store, cast iron, exclusive of patterns. The tender is to be "at how much per cent., above or below the prices inserted in the schedule, he is willing to contract for the supplies;" and only one rate of per centage must be named above or below all the prices in the schedule; and he is to make out his bill at these prices, and add to or deduct from the total the per centage, according to his tender. The generality of tenders are below the prices of the honourable board. The contracts are taken for a term of years, determinable at any period after one year, on either party giving three months notice. Bondsmen, with two securities bound jointly and severally, are taken for the performance of the contract. The superintending officer has the controul of materials as to quality, and imperfections of workmanship, number of and efficiency of men employed. The contractor is to furnish daily a list of men, and weekly a statement of daywork, and how employed, and a list of articles, if any, to which the schedule will not apply. The bills are delivered within 10 days after the expiration of the current quarter, and payment made in the course of the subsequent quarter. In this account of the practice of the honourable Board of Ordnance, we have undoubtedly the nucleus of the principle adopted by the different railway companies; but the chief point, the principle of a per centage, has not been adopted, which I think is the safest for all parties, the company and contractor. I have known the practice adopted by a friend of mine, in a public work of great extent; he sent a schedule of prices to parties, and they were to tender at per cent. on the amount of work (the bills being priced by the schedule) at which they would execute the works. In this mode there is no definite quantity fixed, and therefore no addition and deductions as the works progress, and therefore there can be no extras so annoying to all parties concerned; it is more assimilating to measure and value, with the exception, that the scale of prices is fixed before the commencement of the works. There is a custom amongst contractors of pricing the body of their contract, at a different ratio from that of the schedule, in the expectation that there will be more extra works than deductions here; I warn all parties that so doing, is decidedly wrong in principle and unexpedient in practice. To avoid the above practice, the Manchester and Leeds Railway company inserted two schedules in their proposals, the first containing a list at which the tender is computed, the second containing a list of extra works: in each schedule above 100 items were enumerated. A difficulty often also arises in the measurement of works, as to the custom of the country or trade; and in railway works it is generally expressed, that net measurement only will be allowed, and that brickwork is to include all foundations, digging, pumping water, and all punning[1] or ramming back of walls, backing bridges, &c.

I will now proceed to say a few words on plans, sections, specifications, forms of tender, drafts of contracts, schedules of prices, &c. The two first explain themselves, and the draft of contract is in the province of the lawyer. The specification is supplementary and general; the latter applies to all contracts on a line of railway, and in one case was so voluminous as to extend to 20 folio pages containing 61 clauses. The 61st clause was to the following effect, and will define what is meant by general. "The whole of this specification is to be taken and construed according to the true intent and meaning of it, and in case of the construction of any part of it appearing doubtful, the opinion of the engineer as to the intent of any such portion is to be binding upon both parties." The supplementary specification describes the particular works referred to in the general clauses, as for contract No. 1. No. 5 L, or any subdivision of a particular line, say commencing at chain No. 21, in a field shown in the plan near ———, and ending at chain No. 306, shown in the plan situate near ———, being in length about 3 miles, 4 furlongs, 5 chains, 7 yards, or thereabouts. In the specification a table of the gradients is given, and the number of the bridges, with detailed plans of each. The form of tender is as follows:—"To the Committee of ———. I, of ———, do propose to make and complete the work of the portion of ——— Railway, (inclusive or exclusive of the permanent way, as the case may be), from ——— to, ——— according to the plans and specification, within the period and upon the terms and conditions mentioned and contained in the draft contract exhibited, for the sum of £ *s. d.*, and I have, in the schedule hereto annexed, set forth the prices of the different descriptions of work at which the aggregate amount of this tender is computed, and in case this tender shall be accepted, I hereby undertake to execute a contract according to the draft referred to within 14 days from this date, and propose A B and C D as securities for the due performance of such contract." Again, "I hereby offer to execute the whole of the works described in the specification, &c., and in the event of this tender being accepted, I bind myself to enter into a regular contract, and to find satisfactory security for the due performance of the work, and I agree that the value of any addition to or deduction from the amount of the work specified, shall be calculated at the rates stated in the annexed schedule of prices." In the last case, the real estimate of quantities by the engineer was printed in the schedule, with a description of each kind of work attached, and in the case of the Manchester and Leeds Company before alluded to, the amount of security required was stated in the conditions of the contract; it was, therefore, necessary for the parties tendering to add to their tender. "And I do hereby undertake that A B and C D shall, within a fortnight from this date, execute a bond to be prepared by the Company for that purpose, in a penal sum equal in amount to 10 per cent. on the amount of my tender." The Great Western Railway fixed a definite sum for the bondsmen to become security for on each contract, not a per centage; also that the two sureties be bound jointly and severally with the parties tendering.

Notwithstanding the arbitrary powers of engineers, the complex array of law, and the exaction of bonds, they are all found inefficient as regards keeping contracts within a specific sum, or the gross amount of tenders. Can there then be any thing said in addition to show the inutility of contracts on the usual plan.

I should like to see the principle of tendering now in practice by the Board of Ordnance applied to railways, as before alluded to; and if this plan, with the addition of the quantities (as agreed upon by the contractor and engineer, or by their surveyor) were supplied to intending competitors, I think it would tend to simplify the cost of public works, and at the same time make the officers of supervision and of the executive look more lovingly on each other. I have no doubt, should Government execute the Irish railways, some such system will be adopted by the Board of Trade.

I will, in my next, if leisure permit, enter on the principle and construction of earth wagons, which has not, as yet, had the importance bestowed on it that it deserves. In the mean time allow me to subscribe myself, with all respect,

St. Ann's, Newcastle-upon-Tyne. Your's obediently,

O. T.

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[1] The cost of punning, per cubic yard, is about twopence, or half the cost of excavation.

ROYAL ACADEMY.

Professor Cockerell's Lectures on Architecture.

(From the Athenæum.)

Lecture III.

The chronological table[1] offered to the students was designed to assist their study of the history of architecture, so strongly recommended; it was a sketch capable of great development—the intelligent observation of antiquity was an all-important object with the architect. No consideration could confer more importance and dignity on the art than that it was identified with time—that the architect himself was a part of history, and that the marked works he performs were, by the consent of language, termed monuments. Such a table presented at one view the religious and moral, the political and technical influences which have guided and developed the art. Through the early centuries we trace it as one of the most active engines of civilization; but it is long before we find the table rich with the names of patrons, architects, or works, and then with many voids of tedious centuries between. The dearth of wisdom or wealth in governments, or genius or liberality in the individuals, accounts for the barren ages; as naturally as do the contrary for the fruits of all the muses. They follow each other as natural consequences, as effects from causes. And it is glorious to recognize the coincidence of epochs favourable to art with the most wise-hearted and generous spirits of history.

Under whom were those more remarkable buildings of Egypt raised? It was when Sesostris built his library, and pointed to its destination by the significant and enlightened subscription—Ψυχης ιατρειον—"The health of the soul." When were those bright edifices erected which have ever attracted the traveller to Athens from every part of Europe, and still do so? It was when Pericles could discuss the buildings he designed with a Socrates, a Plato, a Phidias, and an Ictinus—and so, with minor splendour, an Augustus, a Justinian, a Medici, a Louis XIV., a Frederick the Great, a George III., or a King of Bavaria, have known how to illustrate their era; and, however a half-sighted economy has calculated and complained of the cost, history may be defied to prove that states have suffered from these expenses; those wise princes knew how fructifying they were in real commercial benefits; and never wanted the address to silence the item-counting economists. "Do you complain of these expenses?" said Pericles; "I will find the remedy. I myself will defray them, provided you will allow my name to be inscribed upon the walls." He might have added—"You are prompt enough to vote money to carry on an Affghan war, on a pretence, into Sicily, and fill Syracuse with carcases, to your own disgrace and ruin; but these expenses, trifling in the comparison, these becoming ornaments, these productive fructifying decencies of a great state, you grudge."

When Louis's accounts of Versailles were made up, and his Minister of Finance asked what was to be done with them—"Burn them," said the monarch. He knew as well as Necker the secret "that the arts and sciences repay with usury the expenses of the state in providing for their exercise and culture." He knew, too, that they formed not a tithe of those arrogant and unsuccessful wars which he waged with all his neighbours.

But why are the two centuries before our era less fertile in names? because the Roman sword began to supersede the olive branch of Olympia: and why again do they cease after the second century of our era? because the Emperor himself (Hadrian) professed the art, and murdered his rival Apollodorus, the last great architect of Greece. And now, for twelve centuries, they are obscure under the antagonist rules of feudal and ecclesiastical aristocracy, and re-appear only with liberty and the muses.

Again, for himself, the architect lays to heart the care and circumspection due to *lasting monuments*, and the penalty which the absence of these is to inflict on him in the curse

Of Ripley and his rule;

and for his patrons, his duty to awaken them to the seriousness of these responsibilities, the compromise of national honour and credit in works which are nothing less than state matters; and were so esteemed in Athens by the appointment of a minister, the δεμιυργος, answerable for their success. He is humiliated in finding that his own design, with the originality of which he had flattered himself, is but a repetition of former essays. Again, in the contemplation of the slowness of invention, and the imitative nature of our species through centuries. The arch and the dome essayed during 1000 years before they assumed the form of the Pantheon or the Bridge of Narni; and 1400 more are required to accomplish a humble imitation in the dome at Florence. That the Egyptian, Greek, and Roman, as if spell-bound, did as their fathers did—that the monuments themselves are but the copies, more or less altered, the successors of a remote ancestry receding into the night of time. Pliny tells us that the temple of Ephesus had been seven times rebuilt. The oldest monuments of Egypt and of Greece, and of our own countries, are composed of fragments of still ones:—

Vixere fortes ante Agamemnona
Multi: sed omnes illacrymabiles
Urgentur ignotique longa
Nocte, carent quia vate sacro.

"They had no *artist*, and they died."

But the technical reflections on this table are not less instructive. The struggle of 2600 years with the monolithe;—the influence of fashions in the design, and of slavery in the execution, of works, reducing the cost by at least one quarter;—the lever, the lewis, the trochlea, and every engine employed by modern masons, are recognized in all the oldest buildings of the east; Stonehenge being one of the few buildings which displays the infancy of art;—the inferiority of ancient cities in the distant view as a conglomerate of low buildings, to those of the modern world with towers and campaniles;—the changes which customs induce;—the church-bell, which in the seventh century hardly exceeded one cwt., and terrified Clothaire and his troops under the walls of Orleans; then the delight and boast of communities, and gradually becoming 80 tons in the 19th century at Moscow, enlarging during those centuries the towers and structures for its reception, and altering by degrees the whole face of architecture;—the use of glass, in narrow windows in the first century, a vast improvement on Phengytes, used till then; the manufacture of the civilized only, till the 12th century; then infusing colours with unseen lustre—glazing in part only the domestic windows, which had shutters below until the 17th, and now in one sheet filling the entire sash. Meanwhile, architecture bends to this manufacture, and changes its features and proportions with the phases of its improvement. And, lastly, cast-iron, which within 40 years has discovered capacities which will alter the whole structure of buildings. We may say with the poet—

Loin d'ici ce discours vulgaire
Que l'art pour jamais dégénère,
Que tout s'éclipse, tout finit;
La nature est inépassable,
Et le génie infatigable,
Et le Dieu que la rajeunit.

The principle to be inculcated seems then to be the acceptance and employment of every useful element of our art, and so to engraft new features, and bend it to the march of human improvement, as to be consistent with taste, while it is also to the great end of use. Thus we shall obtain new creations in the art—which a servile imitation refuses.

These are amongst the advantageous reflections which the contemplation of the chronological table will give rise to.

This evening the Professor purposed offering some remarks on the principal monuments of civil architecture amongst the ancients. As the ritual prescribed the forms of sacred architecture, so political and civil institutions prescribed those of civil architecture: where monarchs sway we have their palaces, suited to the temporal governor of the earth: regarded as God's vicegerent while living, and as demi-gods when dead, their mausolea endure through all ages, in the Pyramids, or in the Moles Hadriana; and where these are supported by castes, we have the Labyrinth, the Temple Palace, and the treasury—in republics none of these are found, but the temple, the gymnasium, the theatre, the stoa, the basilica, and public works abound; when states are absolutely commercial, as Tyre or Carthage, nothing remains but their name in history; their architecture seems to have been confined to the perishable Trireme.

The uncertainty of future existence made duration in the present the earliest object of solicitude; monuments in the pyramid or the obelisk are the most remote architectural works which have reached us. In 1732 B.C. Jacob raised a memorial to Rachel, "that is the pillar upon Rachel's grave unto this day." "The kings of Egypt," says Diodorus Siculus, did not think that the fragility of the body deserved a solid habitation; indeed, they regarded their palaces as simple lodgings, in which each successively inhabited; but they considered their tombs as their peculiar habitations, as their fixed and perpetual domicile.

The subject of pyramids would never be mentioned without acknowledgment to the labours of Colonel Vyse, which for princely liberality and English endurance and disinterestedness are unparalleled, as indeed also for their great interest, since on this subject, debated for so many centuries, he has left nothing to desire.

But, to the architect, no monument of antiquity could be more precious than the tomb of Absalom, in the valley of Jehosaphat, which is monolithic (for the most part), or rather cut in the living rock, and exhibits an Ionic temple *in antis* (like Solomon's temple), with a Doric entablature, an Egyptian cornice, and a tholus or circular attic, surmounted with a conical top and a pomegranate; all features in perfect correspondence with the reasonable expectations regarding Jewish architecture, which, however original in *plan* and disposition, would never be so in ornamental style, because the comparative smallness of the nation, the fortunes of individuals limited by law, the agricultural habits of the people, their discouragement of taste, and their position between great and flourishing countries so remarkable for its cultivation as to lend their artists to the Jews, whenever occasion demanded, were all opposed to the invention of any peculiar and original style of architecture.

A beautiful representation of this remarkable tomb had appeared in Roberts' "Holy Land;" there could be no doubt as to its identity, since tradition amongst the Jews on such a point might always be accepted as full and sufficient evidence—its perfect correspondence with holy writ (II Samuel, ch. xviii.) is striking:—"Now Absalom in his lifetime had taken and reared up for himself a pillar, which is in the king's dale: for he said, I have no

[1] See two following pages.

son to keep my name in remembrance; and he called the pillar after his own name, and it is called unto this day Absalom's place." Wren calls it "the most observable monument of the Tyrian style." "It were to be wished," says he, "some skilful artist would give us the exact dimensions to inches, by which we might have a true idea of the ancient Tyrian manner."

Labyrinths are amongst the earliest and most astonishing of architectural works; they were found in Egypt, Crete, Lemnos, and Tuscany. Herodotus describes them as surpassing in extent and magnificence: the one he describes (Eut. cxlviii.) was composed of 12 courts, having apartments of two kinds, 1500 above the surface of the ground and as many beneath, in which were the tombs of their kings. "No one could enter them," says Diodorus Siculus, "without a guide." Yet Pliny tells us they were not contrived like the ornament commonly called by that name; in that of Lemnos, says he, were 150 columns turned in a lathe, which a child could move; and this is remarkable as evidence of the use of such a machine in the capitals of the Parthenon, which has been always supposed.

The living use of the Labyrinth is left to conjecture; but we may easily conceive their adaptation to a people of castes, with whom they might be colleges for those aristocratic classes surrounding the throne. We are told that all the youth of Egypt, born on the same day with Sesostris, were set apart and educated with the young prince, and thus it was that he found himself surrounded in manhood by attached companions, who carried his conquests and his fame to the greatest height. Where could so vast a generation be educated but in the Labyrinth?

The Professor doubted the interpretation commonly applied to the so called temples of Egypt; he believed them to be rather temple palaces, in which the temporal administration of a great country was carried on, together with the spiritual. The ruins of Karnac covered 10 acres. Within the walls was inclosed a space equal to the whole length of St. James's Street, and four times its width. The comparison of this plan with that of the Louvre and its courts, with the use of which we are familiar (and exhibited with plans of Luxor and Dendera, and Diocletian's palace, and others drawn to the same scale), would show the high improbability of the employment of such vast spaces for the priesthood alone; and it could be shown, especially at Dendera, that all the public business of the realm might be conducted there, and that the Pharaoh himself very probably resided, as in the Arab villages at this day, upon the broad terraces which these vast buildings afforded, raised into the air, and removed from the vermin, inundations, mirage, and confinement, to which the habitations on the soil of Egypt were subject.

The Pharaoh united the offices of monarch and high priest, and all the dignity and imposing awe which the arts could afford, were associated with his presence. The palace was approached through an avenue of sphynxes of a mile in length. The Pylæ were seen afar off raising a vast front of uniform surface, on which were engraved on one side the Pharoah in his warlike attributes reviewing his troops, charging the enemy, whom he annihilates at a stroke, besieging cities; on the other, in his peaceful, administering justice, and the more sacred duties of his priestly office. In front of this were obelisks (the smallest of which is now in Paris), and colossal figures of the Pharaohs.

The first court equals in size Waterloo Place, from the column to Pall Mall. Here, under a colonade, "the King sat in the gate," with "his princes and counsellors;" this was "his porch of judgment," the sculpture and painting of the ceiling symbolized appropriately the passage of the soul through human vicissitudes to a final judgment.

The columnar grove beyond, 325 feet by 266, afforded a waiting hall (the only cool one in (Egypt for all the court, so pompously described

BEFORE CHRIST.

DATES, AUTHORS, PATRONS, EVENTS.	ARCHITECTURAL WRITERS.	EMINENT ARCHITECTS.	BUILDINGS.
2400			
Noah			
2300			Tower of Babel
2200			
Menes			Walls of Babylon
2100			Pyramids
Abraham			Obelisks
2000-1900			
1800			
Amos or Cheops			Pyramid
Joseph or Chephren			Pyramid
1700			
1600			Arch
1500	MOSES	Beseleel	Tabernacle
Sesostris			Pyramid
			Temple of Jupiter at Thebes
1400			Labyrinth in Egypt
1300		Dædalus	Labyrinth of Crete
1200			Nineveh
Troy taken			Treasuries at Mycene, Orchomenos, &c.
1100	SOLOMON	Hiram	Temple at Jerusalem
1000			
Shishak spoils Jerusalem			
900			
Homer—Hesiod			
800			Cyclopian Walls
Ezekiel			Labyrinth of Lemnos
700	Theodorus	Rhoecus	Temple of Juno at Samos
	Chersiphron Metagenes	Zoilus Rholus	1st Temple of Diana at Ephesus
			T. of Jupiter Panellenius of Ægina
		Agamedes Trophonius	Temple of Cybele at Sardes
			1st Temple of Apollo Didymeus
600			1st Temple of Pallas at Priene
Ezra		Antistates Calleschros	
Æschylus	Agatarchus Democritus	Antimachides Porinos	1st T. of Jupiter Olympius, Athens
	Anaxagoras Silenus		Temple of Jupiter Olympius, Elis
			Theatre of Bacchus at Athens
500	Ictinus Carpion	Callicrates Mnesicles	Temple of Ceres Eleusina
	Theodorus	Agaptus Libon	Parthenon, Propylæa
Pericles	phoceus		
	Argelius	Pheax	T. Æsculapius, Tralles. T. Selinus
Herodotus	Satyrus Phyteus		T. Jupiter Olympius, Agrigentum
Thucydides			Mausoleum. Temple at Cyrene
400	Hermogenes Nexaris	Mæsthes Callias	T. Diana, Magnesia. T. Bacchus, Teos
	Pytheus Theocydes	Tarchesius Archias	
	Demophilos Pollis	Daphnis Demetrius	2nd T. Priene. 2nd T. Ephesus
	Leonides Philo	Denocrates Lycicratus	2nd Temple of Apollo
		Peonius	Pharos at Alexandria
	Silanion Melampus	Sostratus Callimachus	Corinthian Capital
300	Sarnacus Euphranor		
		Polycletus	Theatre at Epidaurus
		Andronicus	Tower of the Winds
200		Cosutius	T. Jup. Olym. Athens, completed
			Gymnasia
100	Fussitius	Hermodorus	Temple of Jupiter Stator
	Terrentius Varro Mutius		Temple of Honour and Virtue
Diodorus	Publius Sattimius	Valerius	2nd Temple of Jupiter Capitolinus
Strabo		Saurus Batrachus	
	VITRUVIUS	Cyrus	Basilica at Fano in Italy

AFTER CHRIST.

Dates, Authors, Patrons, Events.	Architectural Writers.	Eminent Architects.		Buildings.
	COLUMELLA	Vitruvius Cerdo		Baths
Pliny		Seler		Tomb of Augustus
Plutarch		Severus	Rabirius	
	FRONTINUS			Amphitheatre at Rome
100				
		Apollodorus		Forum of Trajan
Pausanias		Hadrian		Temple of Venus and Rome
Lucian		Detrianus		Moles Hadriani
Dionysius				Temple of the Sun at Palmyra
				Temple at Balbec
200				
300				
Eusebius		Metrodorus		
Constantine		Alipius		Temple at Jerusalem
400				
500				
Justinian		Anthemius		St. Sophia
		Isidorus		
600				
700				
800		Romualdus		Cathedral of Rheims
				St. Mark's at Venice
900		Elphege		Crypts of Winchester Cathedral
1000		Buschetto		Duomo of Pisa
		Mauritius		Old St. Paul's
		Lanfranc		Choir of Canterbury Cathedral
		De Carilelpho		Durham Cathedral
		Losinga		Norwich Cathedral
1100		Dioti Salvi		Baptistery of Pisa
		Roger		York Cathedral
		Normannus		Lincoln Cathedral
		W. Senensis		Canterbury Cathedral
1200		Troteman		Wells Cathedral
		Poore		Salisbury Cathedral
		Erwin von Steinbach		Minster of Strasburg
		Louton		Lichfield Cathedral
		Arnolfo		S. Maria del Fiore
1300		Agostino da Siena		Cathedral of Sienna
		Walsingham		Ely Cathedral
		Walter		St. Stephen's Chapel
		William of Wykeham		Windsor
1400				
		Brunelleschi		Cupola of S. Maria
Medici	ALBERTI			St. Francis at Rimini
	CATANEO			
		Cesare Cesariano		Milan Cathedral
		Reginald Bray		Henry VIIth's Chapel
1500				
	PHILIBERT DE LORME	Bramante	Rafaelle	St. Peter
Leo X.	SANSOVINI	Peruzzi	San Micheli	
Julius II.	SERLIO	San Gallo	Michelangiolo	Cupola of St. Peter
	VIGNOLA	De Lescott		Louvre
	PALLADIO			
1600	SCAMMOZZI			
	WOTTON			
	INIGO JONES			Whitehall
	PERRAULT	Bernini	Borromini	Façade of the Louvre
	CHRISTOPHER WREN			St. Paul's
1700		Mansart		
	BLONCEL	Vanbrugh		Arches of Triumph at Paris
		Hawksmoor		Blenheim House
	CHAMBERS	Gibbs		Somerset House
		Perronet	Soufflot	
1800				

Note.—The writings of those in capital letters are still extant.

in Daniel: "the princes, the governors, the captains, the judges, the treasurers, the counsellers, the sheriffs, and the rulers of the provinces." Through these was the approach to the Sekos for the god; and on the face of each column of the avenue were represented on one side Osiris, on the other the Pharaoh.

The paving above all this showed a surface prepared for other buildings, apparently of timber: holes occur for the reception of the posts, very large ornamental spouts for the discharge of sewage and water, IN A COUNTRY OF NO RAIN, and therefore only wanted for the uses of a great family. The parapet walls forming the external face of the temple palace, surmounted with the usual cornice, defend and partially conceal these buildings; and at Dendera especially are chapels for the daily services of the Pharaoh and his family on this higher level, and the staircases by which they arrived at them. These were the "*ivory palaces*," the habitations of cedar, and sandel, and almug woods, alluded to in the 45th Psalm, and in which each Pharaoh might indulge his taste, and be "*glad*," and enjoy exemption from the inconveniences of the nether world.

Some very beautiful drawings, by Mr. Jones, representing the actual remains and restorations of the Pilæ, were obligingly exhibited, by permission of that gentleman. An interesting part of the ruins of Karnac was not to be forgotten, namely, a triumphal gate built by Shyshack on his return from Jerusalem, whence he had taken the golden shields put up by Solomon, as described in 1 Kings, xiv.

The treasuries of Atreus, 48 feet in diameter, and the gates of Mycenæ, and the treasury of Orchomenos, of still larger diameter, are the only monuments of Homeric pretension, unless the Lycian remains, discovered by Mr. Fellowes, can be proved to be of that remote period, and that the taste of Sarpedon can be identified by them.

Amongst the objects of civil architecture, few have had more influence on the art than theatres, both in their external elevation, in the application of the orders in relief on the pier and spandrel of the arch, and in the internal elevation, the scene, which has been the occasion of so much caprice and corruption of taste. The theatre, being constantly employed for parliamentary assemblies, required a permanent scene, as well as moveable, and adapted to the performance. It was a subject of vast architectural study and expense. Pliny (lib. xxxvi.) tells us that Caius Antonius silvered the scene; Pretonius gilt it; Quintus Catullus clothed it in ivory. Scaurus surpassed them all; he raised 360 columns, in three ranges: the first was of marble 38 feet high, the next was in glass, the third of wood gilt. Three thousand bronze statues ornamented the intercolumniations. Curion, unable to surpass Scaurus, built two theatres of wood, which, being back to back, could be turned so as to form an amphitheatre for gladiators, displaying the skill of the Roman carpenters to great advantage.

Vitruvius (lib. vii. c. 5.) lamenting the depravation of taste, tells us that Apaturius of Alabanda offered a design for a scene of two stories, the upper called Episcenius, filled with every caprice, centaurs did the office of columns, pediments were twisted in a variety of shapes; all which pleased the people of Tralles, for whom it was designed; but Licinius a mathematician, exposed its absurdity, and it was accordingly reformed on better principles.

The scene of Laodicea (amongst many which the Professor exhibited) was the most extensive, being no less than 254 feet in length. The theatre of Orange, lately published by M. Caristie, was a valuable addition to our information on the Roman scene.

Palladio's scene of the theatre at Vicenza gives the best idea of its feature of ancient architectural magnificence.

Originally of wood, and continuing so for many centuries, it was not until the third century before our era (232 B.C., the theatre at Epidaurus,) that they were built in stone and marble. The Greek theatre approached the amphitheatre, and was a horse-shoe comprising 200° or more, because the orchestra was reserved also for the performance; but the Roman theatre did not exceed 180°, because the orchestra was occupied by the senators.

The Odeum was a covered theatre, chiefly for music; that of Herodes Atticus, at Athens, was the most magnificent in Greece, and had a roof of cedar. The space covered was 240 feet by 159. The construction of such a roof, without obstructing sight or hearing, or injuring external architecture, offers a problem to the architect of no easy solution, and is one of great interest in the present times, as we are frequently called upon to cover large areas for occasional assemblies.

But as modern theatres were more to the point with students, the Professor called their attention to a magnificent work, lately published on "The great modern theatres of Europe," by M. Contant, which he exhibited.

The amphitheatre was then considered: although of early Tuscan origin, and originally formed in earth or scaffolding, it was not executed in permanent materials till the end of the first century. One in earth had been discovered by Sir C. Wren at Dorchester. That of Vespasian (as shown in a diagram) was too large for the site of Trafalgar Square, Charing Cross, &c. The velarium, 550 feet by 450, with which the colosseum was covered during exhibitions, was a surprising contrivance, and had been made the subject of a work by the architect Fontana. M. Hittorf had suspended the roof of a panorama in the Champs Elysées, somewhat in the manner of the Velarium, with great skill. This work, published, was here exhibited.

The gymnasium, in which the youth of Greece were instructed for the defence and honour of their country, in every department of prowess, was an interesting object of civil architecture. The plan of that of Ephesus, published by the Dilettante Society, was exhibited, and it was gratifying to observe the use which the late Professor Mr. Wilkins had made of this example, in illustration of the text of Vitruvius, which had hitherto been misunderstood.

The Gymnasium was the more interesting as the type of those Thermæ, the Roman baths, which have furnished the great school of architectural instruction, and from which the best inventions of the architects of the middle age, and of the revival, had been derived.

The name, Thermæ, as well as the express declaration of Vitruvius, declare that these institutions were exotic: a refinement adopted from Greece in the time of Augustus. During the first three centuries of our era, seven of these were erected; they were well calculated to indulge that love of luxury which rapidly corrupted the Roman manners under the emperors, as well as to gratify that constant excitement of novelty and splendour, which gave popularity to the government. Some idea of their extent may be conceived from the plan (exhibited) of the Baths of Caracalla laid down upon that plot which is comprised between Regent Street, Pall Mall, St. James's Street, and Piccadilly, covering about 28 acres. Cameron assures us, that those of Diocletian, somewhat larger, afforded hot baths for 18,000 persons at the same time: a bell rung at two o'clock to announce that the water was warm. The mask of a paternal urbanity was often affected by the despotic emperors, who frequently bathed with the people. One day Hadrian recognized an old companion in arms in poverty, scraping himself with a tile instead of the strigil; accosting him kindly, he furnished him with a slave, and all that could be wanted to his future comfort. Such an example could not but be infectious: accordingly when he came again, he was surrounded with poor acquaintances scraping themselves with tiles; but, calling them together, he observed, that being many they could scrape each other, without any superflous expense of slaves or furniture. The Thermæ were in fact vast clubs, castles of indolence, in which every easy exercise of body or mind, and every delight of the senses might be indulged. The gardens, raised about thirty feet above the general level, were adorned with every fragrant shrub and flower; the choicest works of sculpture, obelisks and fountains, exedræ for the enjoyment of the shade or the sun (of a structure well worthy the student's attention) terminated the walks. In the central building was the great hall, the type of Gothic structure in ecclesiastical architecture, namely, the groined ceiling reposing on a column, and abutting on an extended pier, with the nascent flying buttress. The space of the naves (varying from 76 to 90 feet) being twice that of York, the widest of our cathedrals. The area covered, offers the largest space with the smallest obstruction in the support, of any scheme yet devised, and cannot be too much admired. It has been well observed of those structures, that we discern in them the type of all that has been since done in architecture, just as throughout the animal creation we trace the more or less resemblance to the type man. The interest excited amongst the French students recently (as exhibited in their late competition for the grand prize), promises that this admirable feature of ancient architecture will be reproduced in Europe before many years past. It was proposed for the new Public Library at Cambridge; it was employed by Sir C. Wren in Bow Church, on a small scale; and is executed on a still smaller scale, with considerable differences, but with happy application in the Bank of England, by Sir J. Soane. But the cloisters, the surrounding rooms and baths, their various forms and structures, and the happy union of the arch and the trabeated systems, would lead to more observation than can be here admitted. To the students he would say of them,

Nocturnâ versate manu, versate diurnâ.

Palladio designed to have published a book upon them, the drawings for which were afterwards edited by Lord Burlington. Mons. Blouet has published a magnificent work, giving all the restorations and details, which large excavations and very careful study of them enabled him to obtain.

The Basilica is also of Greek origin, as the name imports. The kingly hall was such as Solomon built in the palace of the forest of Lebanon. It was the Westminster Hall of ancient governments for administration of justice, commercial exchange, great public meetings, &c. The building at Pœstum, so called, was more properly a temple, because the Greeks were not accustomed to apply sacred architecture to civil purposes.

The Basilica of Trajan was the most magnificent exemplar of this species of building which the Professor could point out: with its forum, temples, and approaches, it covered 12 acres. The central hall or basilica, 540 by 168 feet, would contain St. Paul's in length and in width, exceeded only in the extreme ends of the cross. The central nave, 278 by 78, would contain the whole of Westminster Hall, in plan as well as in section. In Rome were 18 basilicas, and one at least in every city of the empire. Their subsequent adaptation to the Christian temple makes them highly interesting to the student. Vitruvius, lib. v. c. 1, describes the basilica, and his own work at Fanum, which differs from the usual form in some particulars.

LECTURE IV.

Of the divisions of the art proposed, that of domestic and villa architecture alone remained to be considered. On this subject, two important preliminary remarks were to be made. Firstly, that the republican form of government, which prevailed in the ancient world after the seventh century B.C., greatly influenced the style of domestic buildings, which were expressly unostentatious externally, towards narrow streets, lined with shops, reserving all their elegance for the interior, in the atrium impluviatum—porticatum—the exedra, &c. Secondly, that populations and fashions having been derived from the east, an oriental character was impressed on the ancient habits and arrangements of countries in which (as in Italy especially) the northern and occidental now prevail; as derived from an opposite source. Whoever walks through the streets of Pompeia, after having resided amongst the Turks, will be struck with this fact. The profuse employment of water, in the bath, the impluvium, and in the corner of every street—the narrow street—the secluded mansions, within high walls—the internal air and space—the subdivision of the house into the men's apartments and the women's—the harem—the lightness of the costume—all express migration from warmer climates, and a marked distinction of the races of modern and ancient inhabitants.

The Jews lived chiefly on the terraced tops of the houses, as the Professor presumed the Pharaoh to have done. "Ahaziah" (II Kings, c. i.), King of Samaria, "fell down through a lattice in his upper chamber;" and it was thence that David, in a wanton moment, incurred the curse which fell upon his family. The house top is ever the scene of prayer. "Let him that is on the house top," says our Saviour, "not come down into his house, neither enter therein," (Mark, xiii. 15); yet it is possible that in the latter ages they had adopted the Greek and Roman ichnography—it was, perhaps, through the roof of the atrium testudinatum that the sick man was let down to be cured by our Saviour (Luke, v. 19.)

The narrowness of the streets, and unostentatious style of the houses in Athens, occasioned disappointment to the traveller, as Dicæarchus expressly tells us; in Rome the same; and as the houses were *limited* by the Augustan law to 70 feet high, we must suppose them unattractive. The fragments of the great plan of Rome, inscribed on the pavement of the temple of Romulus, by order of Septimius Severus, and published by Bellori, show the resemblance of the houses to those of Pompeia. It was an extraordinary innovation on the ancient humility of the Roman house, which Cæsar proposed, in demanding permission of the Senate to erect a fastigium, or pediment, over his door.

But the complete account of the Roman aristocratic house is to be found in the "Palais de Scaurus," by Mons. Mazois, as also of the citizen's house, in the "Ruines de Pompeia," so admirably illustrated by that ingenious and lamented architect.

But if the Roman nobles accomplished the admirable works described, in favour of the public, they did not neglect their own comforts. Under the empire they lived as individuals with the income of monarchs; and Strabo tells us expressly that "they built their villas after the palaces of the kings of Persia." The number of them was also extraordinary; for, as Lucullus said, "they were as wise as those birds which change their residence with the seasons."

Cicero had 19 villas, and it was in one of these that Cæsar honoured him with a morning call, and paid him the very high compliment of taking a vomit in order that he might do justice to his lunch. In another he delighted to ornament his library with Greek paintings and sculptures, which his friend Herodes Atticus was always collecting for him.

It was a fortunate legacy to the architect-antiquary which Pliny had left, in the description of his villa at Laurentinum. It had often employed the ingenuity of the architect, since the revival, but with small profit, till the discovery of the ancient ichnography of Pompeia. The Professor exhibited his own restoration, founded upon those data, in which, though he differed in some points from his accomplished friend, Mons. Haudebourt, in his elegant version of the Laurentinum, yet he strongly recommended it to the student, on account of the great research and taste shown in the composition. Some of the features he would describe. You entered a small tarium and thence a court in the form of the letter D, surrounded with a portico, which was enclosed partially with glass (the very original of our old conventual cloisters), and thus excluded rough weather. Thence through a gay court into a triclinium, which hung over the sea, and had windows all round three sides, giving the full enjoyment of the air, and view of wood and mountains beyond. To the left of this was a room, at the end of which was a rotunda (in apside curvatum), so contrived as to receive the sun's rays from the rising to the setting: in this was a case containing books, calculated to detain you, and such as "one loves to read over and over again." This arrangement afforded an angular parterre, protected on all sides except the south from the winds, and concentrating the sun's rays—a delightful refuge in the winter season. There were rooms heated by pipes from a hypocaustum, and others to retire to in stormy weather, to escape the roaring of the waves; a large bath for cold and hot bathing; a perfumery; and spheristerium, or fives court; a long gallery (crypto porticus) with windows on either side, which, when opened, admitted the fragrance of beds of violets, and the sun's rays at the rising and setting. "At the end of this," continues Pliny, "is a casino I built myself—my delight: in it I have an *Heliocaminus*, a sun chamber, warmed by windows all round; while reposing on my couch in a recess adjoining, I can see the garden, the landscape, and the sea, through a *glazed door;* I can study in perfect quiet here, and escape all the noise and disturbance of my servants, occasioned by the Saturnalia."

Pliny omits some features of great interest in the Roman house, as the Sacrarium, (the chapel,) in which the Lares (the household gods,) were placed, and sometimes the imagines majorum, of which the Romans, like ourselves, were justly proud. The Tablinium, for the archives, which also received these sometimes; and the Ergastulum, that room of the domestic side of the house in which chastisement was administered to the slaves, in the approved fashion of our schools at this day, as we see by various paintings preserved to us.

Pliny describes his gardens, his figs and mulberries, his gestatio bordered with box, and plantatious disposed in the form of Xystus and the Hippodrome; classical titles, which give a charm to features otherwise insignificant: and since "the world," says Sir C. Wren, "is governed by wordes," they may often be adopted by the architect with good effect, when introduced appropriately and without pedantry.

The attention to the sun's rays in the milder climate of Italy, so conspicuously shown in Pliny's letters, is confirmed by all the [authorities of antiquity.

Vitruvius (b. 6, c. vii.) is very particular in his recommendations to this effect; but the wisest of men, in a still warmer climate, has enforced this point yet more strikingly:—"To make a house pleasant," says Socrates, "it should be cool in summer and warm in winter: the building, therefore, which looks towards the south will best secure these objects, for the sun which will enter into the rooms in winter, will, by its greater altitude, pass over its roof in summer. For the same reason, these honses ought to be carried up to a considerable height, the better to admit the winter's sun; whilst those to the north should be left much lower, as less exposed to the bleak winds from that quarter: for, in short," continues he, "that house is to be regarded as beautiful where a man may pass every season of the year pleasantly, and lodge whatever belongs to him in security."

The modern Italians are not less attentive to aspect, which they significantly express by the proverb, "Dove non viene il sole, viene il medico."

But the most extraordinary villa of the ancient world, was that of Hadrian, at Tivoli, in which he displayed all the acquirements and collections of taste, during 21 years of constant travel through this vast empire; in it was reproduced every remarkable building of the world, and probably every statue of celebrity, since from this magazine the baths of Caracalla were furnished 80 years after, and the Vatican in some of its most precious ornaments. The whole was said to be inclosed in a wall 10 miles in circumference. Pizzo Legorio, Kircher, Contini, and Panini, have engraved and written upon the remains.

The modern villas of Rome, built by the popes and cardinals since the 15th century, convey to us some of those graces in which the ancient villas abounded. In these all the great masters of the revival have displayed their research and ingenuity. They are described in the elegant work of Messrs. Percier and Fontaine, to which the Villa Pia, by Mons. Boucher, has lately been added.

Our own architects of the 16th, encouraged by Bacon, Burleigh, and Wotton, certainly studied these works, and engrafted some of their principles on our Elizabethan architecture, which adapts itself admirably to our climate and the extent of our establishments. Bacon (Essays, vol. I.) describes his idea of a villa with great detail, insisting upon the aspect and the seasons as primary considerations. Indeed, all authorities agree upon this subject, except those of the 19th century, and especially the patentees of hot air or hot water apparatus.

"The Elements of Architecture," by Sir Henry Wotton, being "the Rules and Cautions of this Art cast into a Comportable Method," are amongst the most precious and the earliest in our language. He was long ambassador at Venice, from Elizabeth and James, and seems to have been personally acquainted woith Palladio. Domestic and villa architecture are special subjects with him; for, says he, "Every man's proper mansion and home being the theater of his hospitalitie, the seat of self-fruition, the comfortablest part of his own life, the noblest part of his son's inheritence, a kind of private princedome, nay, to the possessor himself an epitome of the whole worlde, may well deserve by these attributes according to the degree of the master, to be decently and delightfully adorned."

In truth, during three centuries the cultivation of this branch of architecture may be said to be peculiar to England, and that, while monumental and palatial edifices are better illustrated on the continent, the constitution of this country, and of the English mind—prone to the salutary retirements of home, the centre to which all its desires and warmest imaginings are ever pointing—have made the English house of every grade the most perfect in comfort and convenience, and the villa the beau idéal of individual possession, and the branch of the art in which our country excels beyond all others.

The compact square villa, after Palladio especially, was introduced by Inigo Jones, and much advanced by the model of those at Genoa, published by Rubens, who recommends them as full of beauty and convenience, and admirably suited to gentlemen of moderate fortune, such as the republic of Genoa is composed of. But the extension of the habits and the requirements of the present day have outgrown the spuare villa, and we are constrained to build a house beside the villa to accommodate them, with the worst possible effect in the group and in detail; for in vain the plantation attempts to hide it out; an anomalous composition is the result, and we had better have reverted to the Elizabethan mansion, which cast the house and offices into one in the extended E or H, or the French mansion, "enter cour et jardin," of the 18th century, reserving the centre for the best apartments, and the wings for offices, and the entrances in the angles communicating easily with all.

The least rational of English productions in this sort is seen in the castellated elevation adapted to this plan—the battlements and dungeon-keeps of Edward the Third upon the Italian villa of the 16th and 17th centuries. The menacing aspect, the machicolations, threatening hot lead upon the intruders, in the distance, are, on the approach, found to be peaceful and harmless; the fortress is accessible at every window. and expresses a security from danger on better acquaintance, in direct contradiction to its fortified exterior. On entering the baronial hall, where you expect the paraphenalia of chivalry and the chase, retainers and bondsmen, you are addressed by a powdered footman, or may discover a housemaid sweeping the marble pavement.

The Grecian villa is hardly better conceived; it may be taken for a library, or a philosophical institution. An extensive portico, borrowed from Minerva Polias, imposes its order on the whole composition, which is to be compressed accordingly, at the cost of all its internal proportions and accommodations. Every useful appendage of vulgar convenience is to be sxppressed, as ill-suited to its Flatonic refinement. As Swift says of Clelia—

You'd think that so divine a creature
Felt no necessities of nature.

But such architectural solecisms derogate from the dignity of the art, and convert into a theatrical or romantic dream, that which should embody sound sense and rational invention.

The essential features should be prominently expressed; the nobler portions, the offices, kitchen, the clock, and the stables, should tell their own story. And fiction would be found unnecessary when all these are placed in due subordination and proper character by the artist's hand.

France, until recent times, essentially monarchical and aristocratic, has ever delighted in palaces; and since the reign of Francis I., they have been the most remarkable of Europe. Du Cerceau, Philibert de l'Orme, Mansards, and Blondel, and many able successors, afford us the fullest information on the ichnography adapted to these grades. In conception and design, and in many respects in execution also, the Louvre is the most magnificent palace in the world, Situatød in the metropolis, and occupying 32 acres, its galleries, aud museums, and its gardens, form the recreation of the people. The paternal monarch invites them into his courts and vestibules, of which he esteems them the best ornaments, the most familiar and acceptable guests at all hours; participating with them his refinements and his delights, they are endeared and elevated, and the palace of the arts and sciences, a part of the entire composition, and ranging in the axis of the first court, forming the chief object from its windows, assure them of the nobleness of his views for their honour and real advantage. The palace itself, the work of centuries, still unfinished, is the great attelier of artists—the field in which they may exercise their genius for centuries to come in their several works—the great harbour in which talent may find protection and employment.

It was for the foundation of such schemes as these, that Francis I. invited Vignola and Serlio, and the painters of the school of Raphael, into France; and for their transmission to posterity, that he encouraged the publication of Cæsari Cæsariano's translation of Vitruvius, and the elementary works of Serlio and others, which obtained for him in return the title of the Father of Literature. Nor were his successors inferior in these encouragements, which enabled native artists afterwards to rival the great Italians—for L'Escot was preferred to Serlia, and Perrault to Bernini.

The pecaliarity of French orthography is in the high roofs, subdivided into pavilians, affording great effect in composition of various and cumulating forms, aided by their high chimney shafts and dormer windows, aud their vast windows below them, suited to the northern climate. Indeed, Philibert de l'Orme, and the architects of his day, have rendered the Italian style homogeneous with the northern climate and circumstances in the happiest manner.

A military people delight in pavilions; each apartment was to represent a tent. So in the Tuileries the line of tents is terminated with two, distinguished by the name of Pavilions de Flore and Marsan. A maritime people delight in their ships: thus the English apartments convey the idea of "between decks," and the larger buildings are often like the man-of-war hulk laid up in ordinary. So in Russia the palaces have the air of barracks; vast and forlorn, they remind the spectator of the plains of Siberia. In Egypt, the Troglodite excavation was revealed in the temple palace; in Greece, the log-house in the temple structure: in China, still the tent, in its simplest form.

In the middle ages domestic architecture arose from the monastic structures in single rooms, lighted on either side like our colleges, the chimney shafts issuing from the eaves. The composite house of double rooms was borrowed from the Italians by Francis I., but even there the *degagement* was wanting, and the chamber, ante-chamber, waiting-room, and guard-room, were all passage-rooms. It is in the English palaces that this problem has been best solved.

But the Professor observed, that this digression had led us from the chronology of the art, which terminated with the Roman villa; and we now entered that melancholy period of history, in which all ancient ideas of human enjoyment were absorbed in loftier and more serious aspirations; and the art during the next 1000 years was employed alone in military and ecclesiastical buildings, by means of the Freemasons. The original institution of that order is traced even to the Greeks and Romans. Numa established the first corporations of architects, Collegia Fabrorum, together with the inferior Collegia Artificum. They were invested with a religious character, and rights of framing laws and treaties amongst themselves. They greatly contributed to the increase of the Roman power amongst the barbarians, as have done our own people amongst the North American Indians, with whom an article of treaty on their part, has always been to send a blacksmith amongst them. The Collegia were greatly promoted by the Roman Emperors in the rebuilding of cities, in the aqueducts and public works, and endowed with peculiar privileges, as freedom from taxation, holding councils with closed doors, &c. Victor relates that Hadrian was the first to attach a corps of architects to the Cohorts (about 120, A.D.)—an example which the admirable College for Civil Engineers at Putney, in favour of our colonies, promises to follow with great advantage.

But it was at the termination of the eighth century, that the masons of Como assumed their peculiar form of Freemasonry, raised into importance by the patronage of the commercial and zealous Lombards, in the building of churches and monasteries with new materials; and dispersed after the destruction of that kingdom by Charlemagne, they spread themselves over Europe, obtaining bulls from the Pope, and maintaining peculiar rights and mysteries. Collegia had existed in England; but, destroyed by the ravages of the barbarians, the Freemasons (probably of Como) were invited by Alfred, and after by King Athelstan, who gave them a charter in York (926), the original of which is said to exist still in that ancient city. It cites the Oriental Church, the history of architecture from Adam, with Rabbinical tales of the Building of Babel, the Temple of Solomon; Hieram, the Greeks and Romans, Pythagoras, Euclid, and Vitruvius, are quoted; that St. Albanus (300, A.D.) obtained a charter from King Carausius, with sixteen laws, agreeing with the *corpus juris*, relating to the Corpora or Collegia of ancient Rome. Another precious document preserved to us was written in 1450, under Henry VI., a great patron of architecture, published in the *Gentleman's Mngazine* (1753, p. 417).

In 1459 a grand lodge was erected at Ratisbon, of which the architect of Strasbourg cathedral was the grand master. Charters and privileges were added by Maximilian, 1498. In 1717, Sir C. Wren was the grand master in England; but shortly after the ancient fraternity altered its original form and purpose, and became what we now understand by Freemasonry. Wren was then extremely old, and probably unequal to oppose the perversion which then took place; and which, from his known services to the craft, we cannot doubt was contrary to his wishes.

Thus the period of the revival was arrived at, and the Professor explained that in the previous and the present lecture he had devoted the more time to the review of ancient, sacred, and civil architecture, from the persuasion that the art would never again effect similar productions; therefore that antiquity formed] that great storehouse from which the architect was to draw his best instructions.

It might be said, that the problem of architectural power and combination had been worked out and solved, that the mastery of the ancients was admitted, and that such works would never again be performed; it would not again become a primary instrument of civilization. The human mind had passed through that stage of its discipline, and had embraced new sciences, engaging the faculties in occupations more advantageous to the improvement and happiness of our species. The intellectual growth to the manhood of our nature, now perhaps attained, would esteem architecture ever a powerful engine in the attainment of the sublime and beautiful, but would probably never again indulge that preponderating regard given to it by the ancients.

The middle ages laboured after the ancient models with many divergencies: in the revival with the muses, the conviction of their pre-eminence was admitted, and their laws and principles were confessed as unalterable. Nothing then was wanted but to revive them, and the zeal with which this object was pursued was immense.

In 1416, Poggio Bracciolini, in searching for manuscripts, discovered a copy of Vitruvius, "covered with dust and rubbish, in a tower not fit to receive a malefactor," says he, "at the monastery of St. Gal, at Constance." Copies of this happy revelation were spread amongst the learned, until the invention of printing, in 1445, multiplied them amongst the great architects of the day—Brunelleschi, Cæsariano, Bramante, and others. The magnificent Alberti was one of the chief of these, but not finding in Vitruvius sufficient to inform and fire the student's mind, he composed that work which all competent judges have esteemed the most masterly compilation in the art extant. "Seeing," says he (lib. vi.) "that of all antiquity Vitruvius alone has reached us, that such chasms and imperfections appear in his work, that his help is insufficient: his language, too,—Greek to the Romans, and Latin to the Greeks—leaves so much unintelligible, I thought it the duty of an honest and a studious mind to free this science from ruin; though the rehearing without meanness, reducing to a just method, writing in an accurate style, and explaining perspicuously so many various matters—so unequal, so dispersed, and so remote from the common use and knowledge of mankind—certainly required a greater genius and learning than I can pretend to," &c.

But he did not confine himself to the theory of his art; as a scholar, a mathematician, a Platonist, and of a noble family, he associated with all the greatest spirits of his day, and was intimate with the living masters and the progress of their works. Whatever comes from him, therefore, is generous, moral, philosophical, practical, and elevating: he proves himself truly of the order of cavalieros; he mounts you upon his horse, which quickly you find a Pegasus; he raises you above the vulgar cares and labours of this nether world, and in his airy flight he shows you all the kingdoms of the world and their handiworks; and then he sets you down, cheered, instructed, delighted, and exulting in your profession.

The only English edition is that of Leoni, 1755. The spirit of that day deemed art a primary instrument of civilization; it became the boast and the occupation of the little courts of the rival states of Italy; literary societies, discussions, and conversaziones, discovered and refined upon the true principles of poetry and of fine arts; and a Bembo, Sadolet, Annibal Caro, Castiglione, Aretino, and a host of literary stars, all contributed their zeal and means to the æsthetical intelligence of artists. Architecture became the field of poetical imagination: and we have the Ὑπνοτερομαχια, "The sufferings of love in a dream," by the learned friar, Collonna, in which the wonders and delights of the art, and of its theories (full of original and beautiful conception, the source from whence the artists of the day drew continually), are accompanied with the romantic and amorous adventures of blighted love, of which the author was the victim. "The Dream of Poliphilus," printed by Aldus, in 1499, was published in French in 1600, with new plates, engraved from the drawings of Jean Gougeon.

From that period (early in the fifteenth century) to the present day we have a race of able architects in an uninterrupted chain, each adding some new grace or invention to the art, on which their merit and celebrity are founded; all these we now appropriate without appreciating their difficulties, and these progressions; or due acknowledgment to each for the contributions gradually made to our common stock. On the accompanying drawings of some of the great works of those masters, on which our present practice is based, the Professor proceeded to offer some comments. It must be premised that the revival found the art under very different circumstances. The growth of liberty in the middle ages, magnifying the individual, whose house now became his castle, an aristocracy balancing the kingly authority, the increase of commerce, and many other causes, altered the whole face of domestic architecture; it might safely be asserted, that no palace of the solidity of the Strozzi or of Burlington House, ever existed in antiquity. The remains of the most insignificant temples and public buildings are still found, but the absence of any remains of such solid mansions as those throughout the ancient world might be adduced in proof that the domestic architecture of the ancients was slight and ephemeral. The houses of the ancients, like those of the Turks, were of wood and brick, covered with plaster and with paint. Columns, indeed, abounded, but they were moveables, or furniture, the objects of manufacture at the quarries, and of trade. These reflections were sufficient to show, that the features which the architects of the revival, in their endeavour to restore classical architecture, introduced, were new in execution and design, and required a stretch and effort of mind which we do not sufficiently take into account. Those who may be considered the active restorers of architecture are—Brunelleschi, Bramante, Alberti, Peruzzi, Serlio, San Gallo, Michael Angelo, Raphael, San Micheli, Sansovino, Galleazzo Alessi, Vignola, Palladio, Scammozzi, L'Escot, Philibert de l'Orme; many others might be added, but none more remarkable than these. The question occurs, in what particulars were these men great? the answer will always be, that not only were they eminent practitioners, but they advanced their art, and contributed new views and inventions towards its perfection.

The first essays were in imitation of the system observed in the colosseum and the theatre, namely, the column and trabeation in relief, and superposed upon the frieze and arch, and this, in a small scale, formed a crowning order upon the tower on which Brunelleschi raised his dome at Florence. The same difficulties of constructing the trabeation, and of finding stone of sufficient size, and of funds for opening the quarries, which had induced the decline of architecture under Diocletian, occurred in its restoration; and it required the experience of one hundred and fifty years to suspend the disengaged entablature in the ancient manner, with any boldness of scale and projection, as in Perrault's Louvre, about 12 ft. 6 in.

Brunelleschi, in his church of St. Spirito and St. Lorenzo, employed the orders in good proportion, but these supported arches. The celebrity of Bramante's St. Pietro, in Montorio, doubtless arose, in great measure, from the accomplishment of the trabeated entablature, though the scale was indeed small, only 3 ft. 10 in. from column to column. But the timid application of the classical orders to the middle age buildings, often of large dimensions, gave them rather the character of trinkets hung upon them than of constituent parts of the fabric. Bramante, indeed, made a great step in the palace of Cardinal Wolsey, but the orders are still delicate in low relief, the windows circular-headed (from the difficulty of executing the square trabeated head) with the horizontal entablature above them. The basement, though elegant, has a gothic character, and the crowning cornice has but a small projection; the whole is dry and timid. But Bramante had the merit of inventing the coupled columns, which gave breadth and proportion to the front not otherways attainable. The ancients had left no examples of this disposition—but such were its advantages that it was at once accepted by Raphael and his successors; Perrault used it in the Louvre and Wren in St. Paul's.

Alberti's bold and master mind originated many of those features which his successors knew how to adopt, particularly in his church at Mantua; he gave the hint which M. Angelo followed in St. Peter's, of incorporating the whole height of the interior (not done till then) in one order, and vaulting the ceiling. His church at Rimini bears the stamp of Roman magnificence, quite beyond his age.

Peruzzi was the first to render his orders homogeneous with the structure, and his giving to the entablature of the upper order (especially in the Farnesina) a proportion suited to the entire height of the two, was as beautiful as it was new; it was afterwards adopted by Sansovino in the library at Venice with the greatest effect.

But Peruzzi executed an entablature in the Palace Massimi, and square-headed doors of no mean dimensions (six feet six inches between the capitals); but it was especially in perspective that he made advances far beyond the conception of his day. In other particulars, the merit of Peruzzi is unfolded by Serlio, his pupil, who possessed his collections and published them, through the patronage of Francis I., in the first elementary work on the art written since the revival. The first edition in French is dated Paris, 1545; it was translated into Italian at Venice, 1550, and, by Robert Peake, into English, 1611, under James I.

San Gallo was remarkable for the dignity which he gave to his buildings (especially the Palace Farnese), without the aid of the orders, except in subordinate dimensions, in the windows only, and in the interior court and vestibule. The verticality which is designed and usually conveyed by the orders he communicated to his buildings by rustic quoins, which carry the eye up, and enable it to embrace the whole front. This invention, which appears to be wholly his own, became popular and universal.

The windows, with their small orders, are undoubtedly taken from the Roman tabernaculum, or ornamented niche, so often seen in the baths and in the Pantheon, and was also a new application.

Raphael, as great in architecture as in painting, adopted his master Bramante's invention of coupled columns, as also San Gallo's windows and quoins, and if he did not invent, he employed the balustrade with singular grace and effect—for grace united with strength and nobility, his palace Pandolfini, Caffarelli, and Uggieri are unequalled; indeed, his letters show his enthusiasm for architecture, his profound estimation of the antique, and his ardent aspiration for the restoration of Rome to its antique character and splendour. The backgrounds of his pictures are not less to be regarded as examples than his executed works, being designed with as much care as if they were to have been perpetuated in marble.

M. Angelo distinguished his designs by vastness and singularity, compared with the previous schemes of Raphael, Peruzzi, and San Gallo. We are surprised at his boldness in proposing one order, eight feet in diameter, for the external front, and a corresponding disengaged entablature for an extended portico in the west front—which latter, however, was never attempted. His palace of the Capitol has many merits and peculiarities, one of which, practised in the Laurentian library also, was the sinking his columns in niches.

Vignola has been deservedly regarded as a master of the first merit, and has been hitherto the great authority in the French school, as Palladio has been of the English. His stereotomy, profile, proportion, and composition are admirable; his orders are generally subordinate, often at the top of his buildings—they are never coupled as in Bramante and Raphael, but he reconciles the wide intercolumniation by a panel which gives proportion and sustains the pilaster with excellent effect. This expedient, much followed in Italy and in France, was original with him, as was also his modillion cornice, extending to the frieze, and giving extent and importance to the entablature, proportioned to the whole height of the building, in a better mode than that of Peruzzi. This beautiful invention is recommended without ostentation:—" Questa cornice," says he, " la quale ho mesa piú volte in opera per finimento di facciate, ho conosciuto che riesce molto grata." This cornice was made the termination of the fabric, on which he never permitted a blocking or balustrade. But Vignola was chiefly remarkable for an artifice of composition, which, by subordinating the parts, gave apparent vastness to the whole; his doors and windows are remarkably small, the latter 3 feet 8 inches by 7 feet, only in Capralola—but, being finely proportioned and complete in their members, deceive the spectator into the belief of actual scale. This artifice has been much used by his successors, especially in the upper portions of churches, with good effect, where no means of comparison or admeasurement are offered, just as a man becomes a giant when seen upon a hill and against the clouds.

Sansovino, the Lombardi, and San Michele, Palladio and Scammozzi, formed a school peculiar to Venice, uniting sculpture in the happiest manner with architecture. In the library of Venice, one of the most beautiful buildings of the world, Sansovino adopted two orders, to the upper of which he applied the deep frieze and entablature suited to the *entire* height, after the invention of Peruzzi, the intercolumniations being occupied with the Venetian window, so much employed afterwards in England—these windows having columns doubled transversely in the thickness of the wall, by which an amazing solidity and richness is communicated to the architecture; an arrangement subsequently adopted by Palladio in his town house at Vicenza with admirable effect.

San Michele, chiefly a military architect, and who first gave the gates of cities the character afterwards universal, is remarkable for the energy, richness, and expression given to his works. His employment of the orders and of rustics is exemplary. His gates at Verona, and his palaces in Venice, especially of the Grimani, are masterpieces.

Palladio, by much the most laborious and learned architect of the revival, produced his effects by a happy employment of two orders, the one on a scale comprehending the entire height, the other subordinate, comprehending about two-thirds of that height. This principle had been employed by the ancients in the adjustment of side porticoes to the temple, and in the Propylea of Athens. In this last, the subordinate being 10, the principal is 15; in the Casa del Capitano, it is 10 to 16½; the same in the Basilica; in the Casa Valmarana 10 to 20½. This principle may be regarded as the secret of Palladio's magnificence, just as the subordination of windows and features was of Vignola's. But his employment of the arch in conjunction with the trabeated arrangement adopted from the baths, his classical plans, his mastery over all the features aad parts of architecture, cannot be enough studied.

The two volumes on the architecture of Venice, by Cicognara—the single volume of the works of San Michele at Verona, by Albertolli—and the works of Palladio, by Bertotti Scammozzi, should be within the reach of reference to the architect at all times.

The pompous Scamozzi (braggadocio, as Inigo Jones calls him, probably from personal acquaintance, in his visit in 1614,) was a follower of Palladio, though he assumed to be an inventor. He was, however, the first to accomplish a portico, of any size, with a disengaged trabeation, in the church of the Theani. He was chiefly remarkable for the employment of orders above orders in well-studied proportions.

Galeazzo Alessi turned the peculiar locality of Genoa to immense advantage, and was the most active of those who have stamped upon the architecture of Genoa that sumptuous character so original and exemplary. This architect was in frequent competition with Palladio and Vignola at Brescia, Bologna, and other cities.

L'Escot and Philibert de l'Orme, in France, laboured with great advantage on the materials thus offered by the great masters of Italy; and they are chiefly remarkable for their adaptation of their inventions to the requirements of a northern climate, in large windows, chimney shafts, high roofs, &c.

The student will add many more peculiarities and titles of merit to the great masters of the revival from the hints here offered.

AN ARCHITECTURAL DOCTOR, AND ARCHITECTURAL IDLERS.

Sir—Whatever may be the merit of Mr. Gwilt's work, as one of elementary and practical instruction—and he must have been ingenious, indeed, to have got up so bulky a volume without at the same time bringing together information, new as such to many, if not to all—whatever merit, I repeat, it may so have, the intolerance and illiberality not only betrayed in it, but in many places openly expressed, are not very creditable to him, nor likely to recommend his book. The most that can be said in his favour is, that he does not stoop to flatter, nor has even attempted to conciliate the good opinion of, those whose opinion is likely to have some influence in stamping the character of his " Encyclopædia." It is to be hoped that the bulk of the profession—at any rate those who follow it as a liberal art, do not at all agree with him in his "bow-wow" depreciation of a class of persons to whose labours in the study of Gothic architecture we are greatly indebted, and professional men themselves not least of all. It may be fairly questioned if that style of the art would have been revived among us at all, but for the diligence of extra-professional students, and the attention directed to it by their writings.

It might be thought that, if not disinterested generosity, at least a sort of enlightened and generous selfishness would induce architects to encourage as much as possible a taste for the study of their art—and without some study, a taste for the art itself cannot be acquired—and to aid in removing the prejudices which deter persons in general from approaching it, under the false notion of its being entirely a practical one, mechanical, dry, and repulsive. Whether any of his brother architects will now side with Mr. Gwilt, remains to be seen; but in my own opinion they have very little cause to congratulate themselves upon having a champion in their ranks, who would show his prowess by hewing down, and putting *hors de combat*, all the volunteers engaged in the same cause. Much liberality I did not expect from Mr. Gwilt, but I certainly did suppose that he would exercise a little more discretion than he has done. I did not, for instance, imagine that he would allow his antipathy to German architecture to prevail so far, as to give no account of any of the numerous fine buildings erected in that country during the last 30 years; and as not to applaud the zeal with which architecture is there cultivated, if he could not say much in favour of the taste displayed in it. Had he done so—and the same with regard to other countries, those chapters of his work might have been made to contain a great deal of quite fresh and valuable information. The reason assigned by him for not doing so, is a most flimsy and childish one—perfectly ridiculous; for according to that, there ought to be no such thing as criticism on contemporary works at all; nor ought any to have yet appeared relative to those of a Thorwaldsen, a Cornelius, and other great living masters in their respective arts. Besides, he might have executed that part of his task very *innocently*, and without giving the slightest umbrage to any one, by abstaining altogether from criticism and comment, and confining himself to description and mere matter-of-fact information. At present, his apology for passing over altogether what he was conscious would naturally be looked for, sounds too much like the fox's—"the grapes are sour." The real reason, there can be very little doubt, was his inability to make the necessary research, and collect materials for that part of his work, wherefore he would have done well to obtain assistance for it. Considering his avowed and unqualified dislike, or I might say, hatred of modern German architecture, it is not very surprising that he should not have referred us to any of its chief productions, lest the bare mention of them should be mistaken for approbation. Yet neither does modern Italian receive better treatment from him, for he says nothing of what has been done in that country, within the present or even the last century, excepting the palace at Caserta. There is not a syllable relative to such architects as Calderari, Temanza, Selva, Piermarini, Cagnola, Niccolini, and a great many others, whose works display quite as much ability and taste as some of those which he most highly praises. Nay, though he expresses so very high an opinion of modern French architecture generally, it is only in general terms, without either describing any thing of the kind, or showing it in a wood-cut. In fact, he has not introduced any fresh subjects among his "illustrations;" and of his "more than 1000 engravings on wood," the greater part are mere diagrams, and the rest of very ordinary character. What will ultimately be *that* of his "Encyclopædia" itself, may easily be guessed, for most assuredly it will not obtain a very flattering one either from students of Gothic, or admirers of German architecture, both of whom will not only be disappointed in it, but offended also, more particularly the former, since they are by no means likely to relish the insolently sneering and contemptuous tone in which Mr. G. speaks of the "literary idlers, especially at the universities," who amuse themselves with inquiring into the history of Gothic architecture; which censure, we must suppose, extended by him also to such publications as those by Parker, and Bloxam, their object being to aid, encourage, and promote the study of it, not at the universities alone, but all over the kingdom. But the popular current against which Mr. Gwilt swims, may overwhelm both him and his book; therefore, his opinions may do no great harm after all. What is chiefly to be regretted is, that his "Encyclopædia" is likely to stand for some time in the way of any better publication of a similar nature, because, though there is ample room for one, in one sense, the market for it is, or will be thought to be, pre-occupied.

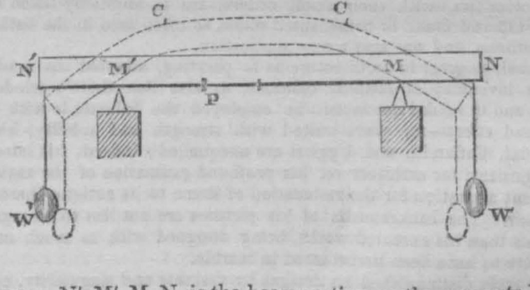
I remain,
Yours, &c.,
"A LITERARY IDLER."

ON THE STRENGTH OF BEAMS.

SIR—One of the greatest advantages which the practical man has over the theoretical, is that of being able to discover any *great* error in a design by mere inspection; this facility in discovering serious mistakes at a "*coup d'œil*" is only acquired by men of great practical skill and long experience, and is a faculty too frequently dearly bought by many failures; the practical man, in forming a design for a bridge or any mechanical structure, seldom uses anything besides a scale and pencil; he rarely commits any great error, but also he is rarely exactly right; on the contrary, certain data being given to the theoretical man, he enters into calculations mostly always long and intricate, and forms his design according to the dimensions obtained from his results; he frequently commits a mistake in his calculations, omits the consideration of some modifying circumstances, and thus his design is faulty, and frequently is only discovered to be bad when the structure falls to pieces; even then he will certainly lay the blame on the builder, like a celebrated French engineer who, being told that a large bridge built according to his design had given way on the striking of the centering, would not believe it, saying, "Impossible, I calculated its dimensions to the greatest nicety."

The sensible engineer will combine theory and practice, and giving to neither undue preponderance, will certainly, *ceteris paribus*, produce the most perfect design; he will neither trust too much to the eye nor rely implicitly on his calculations, and thus he will avoid such a serious error as that which I committed, in my answer to the question on the strength of beams, proposed for solution by "Concrete," and which appeared in your *Journal* of last month; if I had constructed the result obtained by algebra and made a sketch of the beam corresponding to that answer, in short, if I had followed the advice given above of not trusting too much to your calculations, but correcting them by the eye, I should at once have perceived my gross mistake, viz., that of multiplying, instead of dividing, the momenta of the weights by the internal leverage of any point, in order to find the counterbalancing weight.

By correcting the error myself, I shall prevent much useless discussion and comment from your Argus-eyed readers; at the same time I shall briefly explain what I conceive to be the real solution of the question. I stated in my letter of last month, that the true and best form to give to the beam is the parabolic; this being however deduced from erroneous calculations, must be altered, and a result much more simple and satisfactory will ensue by modifying the equations in one or two steps, dividing, in place of multiplying, the momenta of the weights by the lengths of the internal segments at any point between the supports, in order to find the equivalent weight there. For the purpose of rendering my explanation more clear, and making the action of the weights on a beam so circumstanced, more intelligible, I add a sketch of the form it will assume before it attains the point



of fracture. N', M', M, N, is the beam resting on the supports M', M; the distance between these is 6 times that of the points of support (M', M,) from the extremities N', N, to which the equal weights W', W, are applied, to find the best form of the beam between the points of support. On first applying the weights, the part between the supports cambers, as represented in the sketch by the dotted line, and assumes a circular form, becoming more flattened at the centre as it approaches the point of fracture, and ultimately breaks at or about the points c, $c_{\prime}$. I am indebted to a friend, on whose accuracy I can depend, for the account of the experiments from which this explantion has been deduced; you will observe how precisely it agrees with Concrete's statement of the points of fracture as deduced from his own experiments; I must here apologise to him for having cast a doubt on their accuracy; I could not account how the beams could give way at these points; which more particularly made me suspect some error, is his statement that the bar of iron broke in *two* points. The experiments I brought forward in support of my explanation in your *Journal* of last month, were conducted on such a small scale that I am not in the least astonished at the fact of the model yielding in the centre. It appears from the above sketch how the beam may remain in a very curved position without breaking; the leverage of the weights decreasing as the beam approaches the point of fracture. In the following investigation, I shall however omit the deflection of the beam and its weight. What then is the weight which, placed at any point (P) between the supports, will balance the two external weights, and what is the effect of its strain at that point?

From the principle of the lever, it is found equal to W. MN ×

$\frac{MP + M'P}{MP \times M'P}$; but the strain of any weight at the point P, as is proved in all works on mechanics, is expressed by the product of this weight, and the fraction $\frac{MP \times M'P}{MP + M'P}$, and consequently in this case by W × MN; that is the momentum of the external weight, a constant quantity, but since the strength of the beam at any point is proportional to the breadth multiplied by the square of the depth, the breadth being the same, it ensues that the beam should be rectangular. If the weight of the beam was taken into consideration, it would appear that the depth of the beam should slightly increase from the centre to the supports; and it is because this weight acts with greater effect at the centre that, in the experiments alluded to above, the beam broke near the supports. In practice, therefore, the beam should be made *rectangular*, unless its weight be considerable, in which case its depth should slightly increase from the centre to the supports, according to a law easily deduced by introducing the action of its weight at any point in the above equations.

The strain at any point between the supports is W. MN, and at any point outside the supports, W multiplied by the distance of the point from the extremity. The strain is therefore less externally than internally.

You would greatly oblige me by inserting this letter in your next number.

I remain, Sir,
Your obedient,
T. F——N.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

Annual Meeting, Jan. 17, 1843.

ANNUAL REPORT.

This report contains a reference to the proceedings and principal papers read before the Institution last session, and which have been reported in the *Journal* of last year; likewise the receipts and expenditure of the past year, and the following obituary :—

We have to regret the decease of the Right Honourable Lord Congleton, Mr. Samuel Seaward, Mr. Benjamin Hick, Mr. Charles Collinge, Mr. W. D. Anderson, Mr. John Smeaton, and Captain Foster, Bombay Engineers.

LORD CONGLETON.—Sir Henry Parnell was born in the year 1776. After the usual routine of university education he entered early upon a parliamentary career as member for Queen's County, and became distinguished for his steady industry and application to business; his speeches abounded with facts and calculations, and in many political as well as financial questions he took a prominent part. In 1828 he was appointed chairman of the Finance Committee; subsequently he became Secretary-at-War and a member of the Privy Council; in 1835 he succeeded Lord Lowther in the office of Treasurer of the Navy, with which were consolidated the duties of Paymaster-General of the Forces and Treasurer of the Ordnance, which combined office he held until his elevation to the peerage in 1841 as Lord Congleton of Congleton, in Cheshire. These public duties did not prevent him from filling numerous private offices, among which must be principally noticed that of chairman of the Commissioners of the Holyhead Road. This post naturally created an intimacy between him and our first president (Mr. Telford), which was only interrupted by the death of the latter. The active mind of Lord Congleton being thus directed to engineering pursuits, he cultivated the society of other civil engineers, and became an honorary member of this Institution in 1833; his Treatise on the Construction of Roads, and his plan (adopted by the Post-office) for improving the construction of mail coaches, show that his acquirements in the practical details of professional subjects were not superficial. He published also several works on finance, banking, and the currency, besides pamphlets on Catholic Emancipation and other political subjects. The decease of his Lordship took place in the sixty-sixth year of his age, respected as a public character for his attainments, his general consistency, and his great industry, and regretted by a large circle of private friends.

MR. SAMUEL SEAWARD, F. R. S., &c., was born at Lambeth in the year 1800, and at the age of fourteen years he entered the service of the East India Company as a midshipman: after his second voyage to Bombay and China he relinquished a naval career, and was placed by his brother as an apprentice with the late Mr. Henry Maudslay, in whose establishment he had the best opportunities of acquiring a practical knowledge of mechanics and engineering; of these opportunities he carefully availed himself, and always cherished a grateful recollection of his instructor. After passing about five years with Mr. Maudslay, he entered the service of Messrs. Taylor and Martineau, whence he proceeded to Cornwall, and assisted, under the direction of Mr. Arthur Woolf, in the erection of several large pumping engines; he then undertook the superintendence of part of the works of Mr. Harvey, at the Hayle Foundry, where he had the advantage of the instructions of Mr. Richard Trevithick. In the year 1825 he returned from Cornwall and joined his brother, Mr. John Seaward, in the Canal Iron-works, Limehouse, as manufacturers of marine and other steam engines, as well as of general machinery. The attention devoted by Mr. Seaward to the construction of marine engines particularly, and the successful adaptation of the "direct action" engines[1] (which were, it is believed, first introduced by Mr. Gutzmer, of Leith, on board the *Tourist* steamer), are well known in the profession. His ingenuity and mechanical talents are manifested in all the works undertaken by the firm to which he belonged, and by several scientific pamphlets which he published. He joined the Institution in the year 1828, and became subsequently an active and useful member of council, and our Transactions are indebted to him for a memoir "On the application of Auxiliary Steam Power to sailing vessels on long Voyages." Snatched from among us at the early age of forty-two years, the profession has lost an intelligent and zealous member, and his private friends a worthy and estimable man.

MR. BENJAMIN HICK was born at Leeds in the year 1790, and was brought up as a practical engineer in the establishment of Messrs. Fenton and Murray, by whom at an early age he was intrusted with the superintendence and erection of several large engines, &c., and he was eventually offered a partnership in their works; this he declined, and in 1810 engaged with Mr. Rothwell in the Union Foundry at Bolton, of which he was the managing partner; and in 1833 he established the Soho Foundry, now carried on by his sons in that town. His attention was directed to almost all branches of mechanics, and the ingenuity displayed in his inventions and improvements is generally acknowledged: some of his improvements have become public property without being claimed by him, or its being known from what source they emanated. He became a member of the Institution in the year 1824, and although the distance of his residence precluded his frequent attendance at the meetings, he was a liberal contributor to the collection of models, &c. His good taste, his integrity of character, the encouragement which he extended to talent of all kinds, and the assistance given by him to all public improvements, obtained for him considerable influence in the town of Bolton, where his loss will be much felt.

MR CHARLES COLLINGE was born in the year 1792, and being engaged from an early age in mechanical pursuits, he eagerly embraced the proposition of your vice-president, Mr. Henry Robinson Palmer, to unite with him and a few more young men[2] in forming a society for mutual improvement, by discussing scientific subjects; from this commencement, in the year 1818, has arisen the Institution of Civil Engineers, which now numbers five hundred and twenty-five members of all classes. Mr. Collinge continued, through all the stages of its progress, an useful and active member; he took his share of the duties as a member of council, and filled the other offices of the Institution with readiness, and his attendance at the meetings was very constant.

MR. W. D. ANDERSON was a pupil of our first president, Mr. Telford, after whose decease he travelled in Italy, whence he sent to the Institution a series of drawings of the Ponte Santa Trinita at Florence. On his return he was engaged under Mr. W. Anderson (his father), the engineer of the Grand Junction Water-works, on several surveys and other works. He then gave plans for, and was appointed engineer to, the Exeter Water-works, which situation he resigned in 1837, in order to become engineer to the corporation of Newcastle-on-Tyne, where he constructed some important works. Ill health obliged him to resign this latter appointment in the year 1841, and his decease took place during the last summer.

MR. JOHN SMEATON and Captain R. FOSTER, Bombay Engineers, had only been elected during the past session, and owing to the sudden decease of the former, and the shattered health of the latter, consequent on a lengthened residence in the East Indies, they had scarcely ever been able to attend the meetings of the Institution.

ADDRESS OF THE PRESIDENT.

Before I resign this chair I have to perform the pleasing duty of thanking you for your attention to the Institution, which has enabled your Council to present to you the satisfactory Report that has just been read, and has rendered the discharge of my duty so agreeable. I take advantage of the opportunity thus afforded me, to refer to some points which may not be considered strictly within the scope of the Report of the Council.

Honorary Members.—The Report has informed you of a considerable addition to the list of Honorary Members, by the election of several distinguished individuals.—The following is a list of the Honorary Members referred to :—Field Marshal the Duke of Wellington; the Duke of Buccleuch and Queensberry; the Marquis of Northampton, President of the Royal Society: the Lord Chancellor Lyndhurst; Lord Brougham and Vaux; Sir Robert Peel, Bart., First Lord of the Treasury; Charles Shaw Lefevre, Speaker of the House of Commons; Professor Airy; the Rev. Dr. Buckland; and the Rev. Dr. Robinson, of Armagh. These have been elected, not on account of their rank alone, but because with rank, they hold, or have held, high stations, or have been placed in situations in which they have shown

[1] The engines of the *Gorgon*, the first of a numerous class of Government steamers fitted with that kind of engine, were built at the Canal Iron-works.

[2] Messrs. H. R. Palmer, J, Field, W. Maudslay, J. Jones, C. Collinge, and J. Ashwell.

their desire to advance the sciences or arts connected with Civil Engineering; or because they are themselves eminent as men of science and learning. None of them were proposed until they had, like all other candidates for election, expressed their desire to become Members; and in many instances their wishes have been communicated in a manner highly complimentary to the Institution and to its objects. Indeed it is impossible that public men, who have held the highest offices, possessing only the tithe of the understanding of a Wellington, a Brougham, a Lyndhurst, or a Peel, can be indifferent to the growing importance of engineering to the welfare of this country, or not aware that the greatness, I may, perhaps, be justified in saying, and even the existence of the nation, mainly depend on it. It has been said that the steam engine, rendered powerful and practicable by Watt, fought the battles and gained the victories of the last great war; that by it the mines were drained, and the ores and coal raised, which, when applied to Arkwright's and other improvements, multiplied in effect the power of the country, reducing the price of mechanical labour a hundred-fold, and enabling us to supply foreigners with our manufactures, for which they returned us the sinews of war; and that, hence, notwithstanding an expense, beyond all precedent, continued for a quarter of a century, the country, even if the increase to the national debt were deducted, was richer as well as more powerful and more populous at the end than at the beginning of the war. In this there is much truth, but the effect being indirect is not so obvious. In the late Syrian and Chinese wars, however, there could be no doubt. In both cases the work was done chiefly by steam ships of war; and it could not have been done so quickly or so effectually in any other known way. The steam engine, therefore, may now be considered the great power in war as well as in peace; and hence, in another light, the immense importance of the objects of this Institution, when it appears that the long-boasted wooden walls of Old England will henceforth be comparatively inefficient without the co-operation of steam. I do not mean by this to express any opinion of the justice or policy of the late wars—the most glorious part of them was, in my opinion, their termination. My object is to show why the lately elected honorary members have naturally been desirous of becoming so; why we have elected them, and why we may expect them to take an interest in our proceedings and our progress. But there are other considerations more congenial to our civil position in which the individuals who have not written and published scientific works are to be regarded as worthy of the membership.

Sir Robert Peel, now at the head of the government of this country, has not been unmindful that to the application, by his enterprising parent, of the discoveries of Watt and Arkwright he owes the position and education which started him in public life. At the public meeting in 1824, for erecting a monument to Watt, Sir Robert, then Mr. Secretary Peel, said, "that he belonged to that very numerous class of persons who had derived a direct personal benefit from the important discoveries of Watt, and he acknowledged with satisfaction and pride that he was one of those who derived all that they possess from the honest industry of others." His connexion with us is therefore natural: and by evincing his desire to promote science and the useful as well as the fine arts, he has proved, and I am sure will continue to prove, himself a useful as well as an ornamental member.

The Duke of Wellington, in being, while in office, mainly instrumental in recommending the means for proceeding with the Thames Tunnel, and for completing the approaches to London Bridge (one of the greatest metropolitan improvements), considered that he only did his duty; but Sir Mark Isambard Brunel, and Mr. Jones (Chairman of the London Bridge Committee), consider that to his Grace is mainly due the merit of these great works; and that as Lord Warden of the Cinque Ports, he has always taken a lively interest in the works of Dover Harbour and other improvements upon the coast, I can bear witness, as well as to his knowledge of works of civil engineering, which he has lost no opportunity of cultivating. His Grace's reply to a question by me, as to how he came to know so much of the different plans of sluices for draining, &c., was, that when with the army in Holland and Belgium he had plenty of time to ride round the country and to examine them.

The Duke of Buccleuch has, in being the liberal President of the College of Civil Engineers, shown his desire to advance the profession; and in the formation of mines, railways, roads, bridges, and piers, upon his extensive estates, he gives the best practical illustration of his taste for works of engineering, and his wish to promote the objects of this Institution.

Earl De Grey, as President of the Institute of British Architects, himself in taste an architect, and aware of the close connexion between architecture and engineering, has abundantly shown the interest he feels for our success and progress.

The Marquis of Northampton, as President of the Royal Society, would have had sufficient passport for membership, even if his zeal for science, particularly geology, which we all agree with Dr. Buckland to be intimately connected with our profession, were not known. At the last anniversary of the Royal Society, his Lordship, in proposing as a toast the success of this Institution, referred in very flattering terms to its importance and future prospects.

The Speaker of the House of Commons, Mr. Shaw Lefevre, has been a fellow-labourer with our associate, Mr. Handley, in the application of engineering to agriculture,—not only in the drainage of great districts, but in machinery of all kinds, from the steam plough downwards.—Our member, Mr. Parkes, could fill up a long list of Mr. Shaw Lefevre's exertions in this way. As a Commissioner, *ex officio*, of many of the most important public works, I have witnessed his attention to details which, unless he were fond of engineering, he would not think of, even if he had more leisure than the onerous duties of Speaker of the House of Commons allow him.

I might proceed to remark on the other recently elected honorary members, but they are so well known, and have by their writings shown themselves so qualified, that to do so would be an unnecessary occupation of your time.

The late Mr. Ewart.—Having referred to the subject of our steam fleet, I may mention that, until the year 1835, there was no chief engineer and inspector of machinery for the navy, and that Mr. Peter Ewart, who died during the last summer, first held that office. As he was not a member of the Institution he is not noticed in the report of the Council; but the situation he held, and his talents, will, I trust, be considered sufficient to make acceptable a short notice of some facts respecting him.

Mr. Ewart was born on the 14th of May 1767, at Troquaire Manse, in the county of Dumfries. His father, and two or three generations before him, were clergymen of the church of Scotland. Peter was the youngest of a family of ten children (six sons and four daughters). The father's care was divided between the duties of his parish, his private studies, and the early education of his family, which he superintended,—the result proves how successfully; two of his sons having been well known as among the most eminent merchants in Liverpool, and a third as Envoy of this country at the Court of Berlin, where he died at the early age of 32 years. At nine years of age Peter was sent to the Dumfries parish day-school, where he had the benefit of good masters, particularly of Dr. Dinwiddie, an excellent mathematical teacher. At this period his natural turn for mechanics showed itself. His hours of recreation were spent in the shop of a watch and clock maker (named Crocket), which lay between the school and his home; and so well did he profit by what he saw there, that at the age of twelve he had, from materials which he had collected, made and finished a clock that performed well, and was the most interesting piece of furniture in his bed-room. In his fifteenth year he went to Edinburgh and attended a course of lectures, probably those of Professors Robinson and Playfair, as these distinguished philosophers were subsequently on the most intimate terms with Ewart. John Rennie, the late eminent engineer, had a short time before this begun business as a millwright in East Lothian, and on Ewart's leaving Edinburgh he was sent to Rennie. Ewart told me that he was Rennie's first apprentice; that Rennie had one journeyman; and that one of the jobs of the trio was the construction of a small water-mill (the Knows Mill), upon Phantassie farm, for which a shed was lent by Rennie's elder brother George, who afterwards stood as high as an agriculturist as his brother John did as an engineer. He described to me the scene that took place on the day this mill was started, when, inspired by the success of his first work, his master foretold, to the astonishment of his journeyman and apprentice, his own future greatness.

The facts that the celebrated James Watt was about this time employed in the erection of his steam-engine to work the Albion Mills, which stood at the south-east angle of Blackfriars Bridge, now Albion-place, that he applied to Professor Robinson to recommend to him an intelligent well-educated mechanic to superintend the mill-work, and that Robinson fortunately recommended Rennie, the Lothian millwright, who had distinguished himself in his class, are well known. And here I would call the attention of my young friends to the illustration which Robinson's recommendation, as well as Rennie's success, affords, that a practical knowledge of millwrighting is one of the best, if not the very best, foundation for engineering. Soon after Rennie's arrival in London he sent for his apprentice Ewart to assist him in the erection of the mills,—a proof of his opinion and his friendship. Ewart followed his master. How well he had calculated the expense of the journey may be collected from the fact that the last penny he had was paid as toll for passing Blackfriars Bridge to enable him to reach the mill. For four years, 1784 to 1788, Ewart worked as a millwright at these mills, whence he was sent by Mr. Rennie to Soho, to construct a water-wheel for Mr. Boulton's rolling-mill, and was afterwards taken into the service of Boulton and Watt, to erect their steam-engines. There he had ample scope for his abilities, and the advantage of Watt as his friend; this friendship terminated only with Watt's life, and was continued by the present Mr. Watt, whom I have often heard speak with the greatest respect of Ewart's abilities and excellent qualities.

In 1791 he was sent by Boulton and Watt to fix one of their engines upon the cloth-works of Benjamin Gott and Co., Leeds. Mr. Gott, who was then a young man, and became afterwards on the most public-spirited and liberal, as well as greatest manufacturers in this country, was just the person to appreciate Ewart's qualities; the engine superintendent became his friend, and that friendship remained firm and unchanged for nearly half a century. I have heard Mr. Gott speak in the highest terms of Ewart. The following anecdote, told me by Mr. Gott, proves that others well able to judge entertained the same opinion. A gentleman speaking of Ewart at Gott's table, said he had met with but few better practical mechanics than Ewart. "You have been a fortunate man," said Professor Playfair, who was of the party, "for I have never met with one." In 1795 and 1796 he assisted the present Mr. Watt in planning the buildings and works of the Soho foundry, shortly after which, he quitted engineering as a profession. and became a manufacturer, first at Stockport with Mr. Oldknow, then shortly after in Manchester with Mr. Gregg, and afterwards he took a cotton mill on his own account. His bias being always so much towards mechanics, it is not improbable that his idea was that he could make great improvements in the cotton machinery, and that this led him to engage in the business of a manufacturer.

Ewart remained in Manchester in constant association with Dr. Dalton, Dr. Henry, Mr. Kennedy, and other eminent men, until 1835, when he was recommended by the present Mr. Watt to the Admiralty as a proper person to fill the situation which he held until the time of his decease, on the 15th September, 1842, then in his 76th year. His health had been delicate for some time; but the immediate cause of his death was a blow from the end of a chain which broke when he was standing near it in the Dock Yard at Woolwich. Notwithstanding the long interval between his quitting the practice of engineering and his returning to it, and notwithstanding his age (68 years) when he undertook the office, he gave, so far as I have ever heard at the Admiralty or elsewhere, great satisfaction. The professional responsibility, in his own department, of the steam machinery of the British navy rested upon him, and how well he acquitted himself is proved by the results in China and Syria, and in almost every other quarter of the globe.

Mr. Ewart's change of employment for so long a period of his life has caused his name and character to be less generally known than they deserved to be. Like Playfair, I may say that I never met with a man who had so general an acquaintance with engineers and mechanical men of his own time as Ewart had, but he was not easily brought out. I have often pressed him to record in some way his great store of anecdotes and interesting facts, but my doing so was in vain. To write or even to speak on matters in which he had taken an active part appeared painful to him, and was never done when with more than one or two friends. His knowledge of machines, and particularly of the principles of the steam engine, was very intimate. His admiration of Watt, and his practice at Soho, inclined him to view with some degree of scepticism any innovation in the engine, which he considered to have been almost perfected by his great master; and, for the public situation which he held, this prejudice was probably useful, for the war steamers in active service are not those in which new schemes should first be tried.

Ewart was a warm and persevering friend to merit. My friend, Mr. Hartley, engineer to the Liverpool Docks, considers that he owes his appointment chiefly to Ewart's exertions in his behalf, and Ewart was ever afterwards ready to assist Mr. Hartley with his scientific opinion. Mr. Hartley is conscious of the advantage he derived from it, and considers that by Ewart's death he has lost his best and ablest friend and counsellor. Sir Edward Parry (the comptroller of steam machinery to the navy,) in a note I have lately received from him, states, that "after more than five years' constant and intimate acquaintance with Mr. Ewart, he must declare that he never met with a man of sounder judgment, more amiable feelings, or stricter integrity of purpose; and that he felt he had, at his decease, lost an esteemed friend, as well as a valuable coadjutor in the public service." Sir Edward's note then refers to the late results of the war in Syria, and still later in China, in which he says, "the mighty power of steam played so decisive a part, that these wars, humanly speaking, may be said to have been entirely terminated by steam."

I will close this subject with an extract of a letter, dated in 1793, from Dr. Currie of Liverpool (the elegant biographer and editor of Burns), to Mr. Wilberforce. The letter is given in the first volume of Wilberforce's correspondence. It appears by the description that at that time the distress of the cotton manufacturers was greater than even anything of recent date; that the workmen were in a starving state; and that Ewart, the partner of Oldknow, went to Liverpool to represent the extreme case, and endeavour to obtain the attention of ministers through the members. He had a meeting with Dr. Currie, who writes thus to Wilberforce in order to increase his attention to the statement of the case.

"(Ewart) is no common character; he was with Boulton and Watt as superintendent of machinery, and has an extraordinary degree of the most useful knowledge of every kind, and in a word is one of the first young men I ever knew. These qualities recommended him to the notice of the manufacturers, among whom he exercised his profession of mechanic and engineer. He had offers of partnership from the first houses there, and was actually taken into the house of Mr. Oldknow (of Stockport), at that time the first establishment in Lancashire. Mr. Oldknow was the original fabricator of muslin in this country, aud a man of first-rate character."

Mr. Cotton.—Having referred to the countenance received from distinguished noblemen, I must not omit also to say how proud I am of the communications and presents we have received from my excellent friend Mr. Cotton. Ewart was not more devoted to Watt than Cotton was to his late friend Huddart, whose portrait is, through Mr. Turner's kindness, before me. Watt and Huddart were indeed kindred spirits, I have often seen them together, and at the time and since I have often thought that never were two men better paired in person and bearing as well as in mind. Mr. Cotton was the friend of both. Being governor of the Bank of England, and therefore filling the highest office in the greatest corporation in the world, he has given us very decided marks of the estimation in which he holds us. Following his friend Huddart in the march of mechanical improvements, Mr. Cotton has invented a very beautiful machine for weighing gold coin: it is now used at the Bank, and from his uniform attention we may expect soon to have it brought under our notice.

Thames Tunnel.—Among many engineering works of which this country is possessed, none has, during its execution, attracted so much public notice as the Thames Tunnel, and this even more in foreign countries than in England. In October 1842 the shield reached the shaft on the Middlesex side; and we may therefore congratulate Sir Mark Isambard Brunel in having, so far as the great engineering work goes, completed the tunnel, and accomplished the great wish of his heart. With the amazement with which foreigners consider the abstract notion of a tunnel under the Thames, we in this country of mines and tunnels do not sympathize. We know that if the tunnel had been through the London clay or the chalk, there would have been little difficulty; but this was not the case; the strata were of the worst kind, often entirely silt and quick-sand, which were forced through the smallest apertures. At these times the iron of the shield, little more than an inch in thickness, was the only division between the tunnel and the Thames. On three occasions this ever-watchful enemy succeeded. The second irruption, which took place on the 14th January, 1828, was the most serious, as then not only was the whole tunnel in possession of the Thames, but the shield, the invention of Brunel, and by which alone so much could have been done, was, as if in revenge, seriously damaged by the invader, and the tunnel was left nearly filled with mud. Nine-tenths of those who professed to know anything of the subject, then considered the case desperate, and the works were indeed abandoned until the year 1836; but never, at least since the time of the Roman engineers, who confined him to his present width by their artificial embankments, had Father Thames so determined a general to oppose him as Father Brunel. Armed with a new and more powerful shield, in design a masterpiece of ingenuity and contrivance, and executed in the best manner by Messrs. Rennie, the engineer and his companions renewed the attack; and although twice afterwards beaten back and obliged to surrender possession, he has at last succeeded, and may now, I think, bid defiance to the enemy. It was my duty, as the engineer consulted by the treasury, to visit the works on several occasions, and I can therefore certify to the difficulties and indomitable courage of our veteran member, which never failed him, for the notes which he despatched to four individuals (of whom I was one) on the occasion of irruptions, read as if he were rather pleased that the event had taken place; as if he had gained a victory rather than suffered a defeat; resembling in this respect the bulletins from other great generals, who have not however always been so successful in recovering thetr misfortunes. The difference might be that Sir Isambard had a Wellington, not to oppose, but to aid him. But, seriously, looking at the Thames tunnel entirely in an engineering point of view, we cannot but be proud of the work, and pleased to have the opportunity of congratulating Sir Isambard Brunel on the result of sixteen years (eight of which he spent on the spot) of hard mental and bodily labour. I know no other man who would have so worked, or if he had, could have so succeeded. France, his native country, has reason to be proud of him, as England, his adopted country, is. To Mr. Armstrong, Mr. I. K. Brunel, Mr. Beamish, and Mr. (now Professor) Gordon and Mr. Page, who were successively the assistant engineers, great credit is due; and Sir Isambard has always spoken with satisfaction of their services and of the perseverance and courage of the men, many of whom stood by him in his greatest need as if the merit were to be theirs.

Electric Telegraph.—Having said thus much on the Tunnel, I am induced not to pass over unnoticed Professor Wheatstone's application of electricity for telegraphic and other purposes, considering it strictly within our province, not only from its nature, but its application to railroads and similar purposes. And as respects utility (if there be use in despatch), we need have no apprehension on that account. The velocity of Wheatstone's messenger has reached a maximum, which can safely be said of but few human things, and we ought to be satisfied, as we know that the speed is about 170,000 miles per second—that therefore a message could go to Bristol or Birmingham in $\frac{1}{1400}$ of a second, or round the globe, if wires could be laid for its travelling upon, in one-sixth of a second. The messages upon the Blackwall railway, upon part of the Great Western railway, and some other railways, are carried at this extraordinary rate. The bells in the House of Commons are rung by it, and its uses are extending. Its superiority for telegraphing appears obvious. Professor Wheatstone informed me some years since that by his machine for measuring the velocity he made 10,000,000 of miles per minute. I had named 10½ millions, being the velocity of light —my opinion, erroneous perhaps, having long been, that solar light is a modification of electricity, an hypothesis that seems to dispense with the necessity for the doctrine of latent light, which Professor Moser has introduced to account for his late elegant discoveries; but this is too wide a field to enter on now. My object is to express how much I think the profession and the country are indebted to my highly gifted friend, who has entered upon his important labours with a zeal worthy of the cause, and a success that holds out the hope of ample reward; for I feel convinced, that great as the recent discoveries in electricity or photography are, they are but an earnest of what is to come; that riches are to be extracted from these recently opened mines, of which we have not at present the most distant notion. Unfortunately miners cannot work without tools, and they cannot always, from their own resources, command them. France has, by rewarding Daguerre, and giving, so far as she could give, his inventions as a free gift to the world, set a noble example. I have not heard that Wheatstone has had any public aid in prosecuting his researches; but with our own honorary member as premier, we may depend that the government of this great country will not be indifferent to a matter which involves so much of practical utility and at the same time national glory.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Feb. 6.—WILLIAM TITE, Esq., in the chair.

Mr. Morris read a paper on *Ripon Cathedral.*

Mr. Papworth read a paper explaining the method adopted by him in 1829, to confine the lateral walls, then inclining outward of Trinity church, on Clapham-common. Upon a survey of the building, it was discovered that the brick footings of the walls of the church and tower, were built upon a continuous 4 in. yellow fir planking, containing much resinous matter, and abounding with large knots. In the first instance the trenches were not dug perfectly level, and the bottom course of brickwork was laid dry, thence much of the trench was in winter, subject to wet, and at all times to some moisture. In some parts, particularly the north west angle of the tower, and west staircase, the timber was probably never dry: the nature of gravel, (absorbing moisture freely) upon which the walls were built, of course admits damp air, and the timber is proportionably subject to the decay common to wood when so circumstanced.

The footings were first examined from the vaults, when the timber beneath the brickwork was found to be in such a pulpy state generally, excepting at the knots and closely adjacent fibres, that the walls, both of church and tower might really be said entirely to depend on the latter for support; with the addition of the adhesion of the materials and the strength contributed by occasional cross walls. The planking was very soon removed, and York stone steps and proper underpinning substituted.

Although portions of the church walls, from the parapets down to the plates receiving the gallery floors were leaning outwards, it was found that all beneath was nearly upright; of course this led to an examination of the ceiling, in which, at about the middle, a wide crack appeared running from the west towards the east end. On examining the roof, it appeared that the fissure, and the overhanging of the walls was caused by the pressure outward of the principal rafters, and chiefly on the south side of the church. This pressure outward had disjoined the tie beams, which had been scarfed in no very judicious manner in the middle, (the church being about 59 ft. wide) the scarfing was merely bound together by slight iron bands, and thin iron ties, depending on staples at their turned up ends and some spikes to restrain the lateral thrust; which force had almost wholly disengaged these contrivances, and amply accounted for the effects observed. The roof is of a mixed character uniting the king-post and queen-post arrangement. The queens were framed into the upper rafters, and those rafters, the tie beam and the king-post united and made a roof independent of the other timbers; the usual straining beam between the heads of the queen posts being omitted. The disarrangement of the timbers of the roof, by settlements common to them, and the displacement caused by the thrust, made it proper to prepare for the operation, of drawing the separated scarfed ends of the tie-beams something closer; it not being intended to give very much further effect to the power contemplated, because it might have produced injury to the entire roof, and to the upper part of the walls, the gutters and slating—at least it was considered injudicious to risk so much probable damage.

The object was only to prevent a greater separation of the tie beams at their scarfings, to stop any further thrust to the walls; and it appeared that, by drawing the lower ends of the queen-posts nearer to each other, each having a tendency to urge back its moiety of the tie beam towards the centre, that much might be done, and at no great expense. It being found that the queen-post mortices in the tie-beam were far from being filled by the tenons of the queens, and that to draw them much out of the perpendicular, might produce a further and serious disarrangement of the timbers above. To keep the queens upright, and therefore nearly parallel to each other, the timbers were bolted together through the heads of the queens, through the struts, and through the middle of the king-post; and iron blockings, intended to oppose any movement more than desirable, were carefully fitted and bolted to the top of the tiebeam at the foot of each queen-post. The application of iron rods having powerfully threaded screws and ample washers and nuts, was of course a matter of easy accomplishment, and when put into operation, there would evidently have been no difficulty in bringing the ends of the timbers into close contact; but, as above stated, there was no wish to effect much more than full security; and they were only drawn together enough to close in part, the fissure in the ceiling. As will be evident on reflection, this operation of drawing together the posts might, without due care, have left the tie beams without any check to their tendency to sag, and it was therefore found proper, at the time the iron blockings were fixed on to the top of the tie-beams, to saddle on them iron straps, bolted well through the tie-beams.

The authorities of Clapham church, not doubting the stability of the edifice, directed, in October last, the execution of two additional galleries for about 150 children, when the consequent scaffolding afforded the opportunity of a close examination, and it was very satisfactory to observe that the operation has been completely successful, and that no settlement, nor spreading of the roof, nor further overhanging of the walls, has taken place.

Feb. 20.—T. L. DONALDSON, Esq., V. P., in the chair.

Mr. Godwin read a paper on *Church Building,* which is given in another part of the *Journal* for the present month.

C. W. Wooley read a paper on the *Walhalla,* which we propose to give next month, with engravings.

LICHFIELD SOCIETY FOR THE ENCOURAGEMENT OF ECCLESIASTICAL ARCHITECTURE.

THE first annual meeting of the members of this society was held on the 5th of January, at the Diocesan School Room, at Lichfield, and, was numerously attended. The chair was taken by the Rev. PREBENDARY GRESLEY, upon the motion of the Hon. and Very Rev. the Dean of Lichfield. The report of the Proceedings of the committee for the past year was read by Richard Greene, Esq., F.S.A., Hon. Sec.; and we are glad to perceive thereby that, although in its infancy, and with but small present available funds, the society is stimulating the desirable object of church restoration upon correct principles, and is, in conjunction with sister societies, strenuously resisting the gradual destruction of our venerable churches by time, and that greater innovator, ignorance. We trust the day is arrived when the beautiful remains of those fabrics raised by the piety and skill of our forefathers, and venerated by us, will be rescued from the tender mercies of agrarian churchwardens, and own the fostering care of better guardians.

The report was followed by an address from the Chairman, in which he set forth, in his usual plain and felicitous style, the leading characteristics of Gothic architecture, from the earliest period to its abasement in the reign of Elizabeth, and offered some strictures upon the cheap church building of modern times.

Thomas Johnson, Esq., followed the chairman, with some most excellent practical remarks upon the care to be observed in effecting what are termed restorations. He admitted the great utility and advantage to be derived from the combined talent and enquiries of such societies; but, as a practical architect, he held out a warning to their members to remember the ancient adage, "*Ne sutor ultra crepidam.*"

The proceedings were concluded by the honorary secretary, Richard Greene, Esq., who read a paper upon the sculptures of Norman architecture, in which he advanced the somewhat startling opinion that our earliest Christian church embellishments are essentially pagan, and of idolatrous origin. He supported the proposition with great ingenuity, and most interesting facts, elucidating the paper throughout with numerous drawings.

METROPOLITAN IMPROVEMENT SOCIETY.

On Wednesday evening, 22nd ult., a meeting of the Metropolitan Society was held. Mr. J. Ivatt Briscoe in the chair. The chairman congratulated the meeting on the attainment of one of the principal objects of the society—the appointment of a government commission to prepare a comprehensive plan of metropolitan improvement. From a letter in the hands of the secretary of Sir Robert Peel, it appeared that the new commission had commenced its labours by inquiring into the expediency of an ordnance survey and map of London upon the largest scale, and it was understood that the commission was now engaged in considering the various plans proposed for an embankment of the Thames. Mr. Martin, the painter, said, that for fourteen years he had been engaged in promoting the two-fold object of throwing open the banks of the Thames, and of converting the contents of the sewers, now flowing into the river, to agricultural uses.—Mr. W. E. Hickson observed, that some idea of the pecuniary value of the liquid manure, now permitted to be lost, might be formed from the fact, that in Paris a new contract had recently been signed, by which the contractor agreed to give the city 22,000*l.* for the contents of the cesspools of Paris. Mr. Fowler observed, that as numerous private interests would be affected by an embankment of the Thames, it was very important to watch any proceedings relating to this object, in order that the public interest should not be sacrificed. Mr. W. Lindley was anxious that the new commission in considering any plan for the embankment of the north side of the river, should inquire into the practicability of connecting it with the Essex road by means of a new and broad street running from Aldgate to the Thames, so as to form a practicable carriage thoroughfare from the west to the east of London, which now could scarcely be said to exist.

MODERN CHURCH ARCHITECTURE.

A very clever little periodical, *The Ecclesiologist,* published by the Cambridge Camden Society, has already done much good in counteracting the churchwarden barbarisms that have been too often committed in many of our churches; it is also creating a taste among the clergy for Gothic architecture, which will ultimately be of great service to the profession, and act as a counteraction to the selection of inferior designs by "Building Committees." The selection is frequently governed by favouritism, and much oftener by the want of true taste in those who are appointed to select the designs out of probably 50 or 60 that may be laid before them. We quite agree with the following hint on modern church architecture, and consider that too much attention and money is bestowed in highly finishing the stone work, carving, and other ornaments, when frequently rough scabbled stone work will produce a more pleasing effect than the highly wrought stone, and be done at one-half the expence, consequently it may be used less sparingly than it now is; in fact, very freqnently the whole church may be built or faced with such stonework as cheap as with brickwork.

"How often do we," says the *Ecclesiologist*, "see a simple village church, consisting, it may be, of low and rough stone walls, surmounted, and almost overwhelmed, by an immense roof, and pierced with some two or three plain windows between as many bold irregular buttresses on each side, or having a short massive tower placed at one corner, or in some seemingly accidental position, which nevertheless every one confesses to be as picturesque and beautiful and church-like an edifice as the most critical eye or the most refined taste could wish to behold. And just such another church could be built, perhaps, for seven or eight hundred pounds; while a modern early-English design, with all its wouldtbe elegancies of trim regular built buttress, tripellancet, and curtailed chancel, would contain no more kneelings, cost more than twice the money, and look like a 'gothick factory' after all. And why is this? Because a lofty tower must be built instead of a simple unpretending chancel; or because one-half of the money is expended first in procuring, ond then in smoothing and squaring, great masses of stone, or in working some extravagant and incongruous ornament, so that cast-iron pillars must be placed in the interior instead of piers and arches; whereas the small and rude hammer-dressed Ashlar, or rubble work, of the ancient model, has a far better appearance, and allows a larger expenditure where it is most wanted, in procuring solid, handsome, aud substantial arrangements for the interior."

EDGE'S IMPROVED GAS METER.

Considerable excitement has lately been raised respecting the gas meters, in consequence of Mr. Flower issuing a pamphlet accusing the gas companies of defrauding the consumer by the false registering of the meter, occasioned by filling the meter above the proper level with water; when that is the case, he contends that the meter is registering water instead of gas, whereby the consumer is suffering considerable loss. This did appear to us a very serious charge, and in this age of improvement we felt surprise that this "false registering" could not be avoided, and that there was no scheme to adjust the water in the meter to the proper level, so that the meter should correctly register the exact quantity of gas consumed. Upon making some inquiry upon the subject, we very soon discovered that a meter, combining the requisites just alluded to had been invented and patented by Mr. Botten, and another by Mr. Edge, the well-known manufacturer of gas meters and fittings; but we consider the meter of the latter the best, as it combines other improvements. We have, therefore, much pleasure in presenting to our readers a description and engravings of Mr. Edge's meter, which appears to us to be as perfect as a wet meter can well be.

Fig. 1.

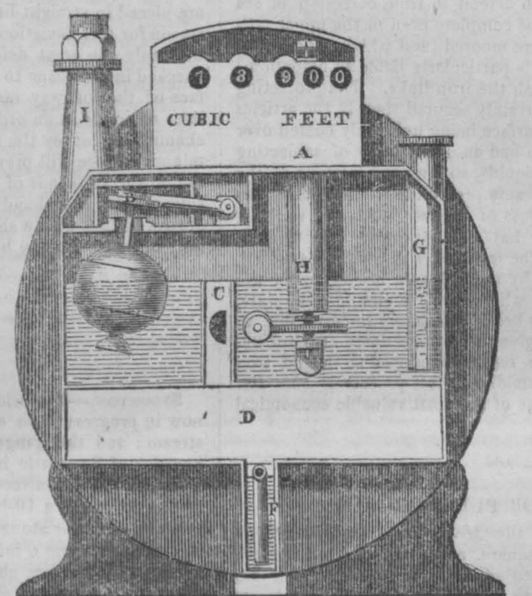


Fig. 2.

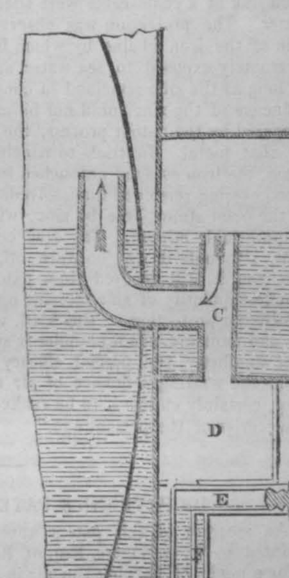


Fig. 1 is a front view of the meter, with the outer casing removed to show the interior, and Fig. 2 is a cross section of the front portion of the meter. A is the improved index. B, patent lever valve. C, syphon pipe. D, waste water cistern. E, F, hydraulic sealed outlet to allow the accumulation of water in the waste water cistern to be drawn off upon the removal of the plug at E. G, tube for filling the meter with water, which dips into the water, and consequently prevents the escape of gas. H, shaft and apparatus connected with index. I, inlet tube through which the gas passes into the meter through the valve B, thence down the pipe C, and again up into the interior or drum of the meter, as shown by the arrows in the section Fig. 2. Thence through spiral chambers within the wheel, as it revolves, to the outside of the wheel, and escapes into the surrounding chamber, and out at the outlet tube, on the top of the meter, at the back of the index box A. As the gas passes through the spiral chambers, the pressure of the gas causes the wheel to which they are attached to revolve, and with it its axis, which is prolonged and passes through to the front box, where, by means of an endless screw on the prolonged end of the axis working into a toothed wheel keyed on to the lower part of the shaft H, and a pinion on the upper part of the shaft, sets in motion the clock-work of the index, which shows the quantity of gas that passes through the meter.

There are several important improvements combined in Mr. Edge's meter, which we shall proceed to describe, the first and most important is an arrangement to prevent too much water being put into the meter. This is accomplished by the patent syphon C, and the waste water chamber D, the value of which cannot be over estimated; for, in the first place, it removes the only dangerous part of the meter, viz., the outlet from the syphon pipe, which is now sealed off; in the second place, it prevents the fraudulent abstraction of the water, to the serious injury of the company: and thirdly, it obviates the only tenable objection to the meter alluded to in Mr. Flower's pamphlet, that is, the accumulation of the water, by which the consumer is deprived of his full measure. The top of the syphon pipe C being placed on a line with the water level, every surplus drop must pass down it into the waste water box D, thence into the pipe F below, and when the plug is removed, it rises up the pipe F, and passes out at the orifice E; and as this pipe is bent downwards, it must always present an hydraulic joint to prevent the escape of any gas that might accumulate in the syphon C, and which, by the construction of the old meter, would escape when the plug was removed. Provided too much water be collected, it would prevent the influx of any gas, consequently it must be at once detected; the consumer would then have only to unscrew the plug E, and allow the water to run off, which may be done without the least danger. It will be observed that there is only one outlet screw, E, instead of two, as in the common meter.

The second improvement is the patent index A, which enables the consumer to ascertain the quantity of gas used with ease and certainty. The complexity of the old method, which consists of 3 dials with the movements of the hands or pointers, has been the occasion of very frequent mistakes and misunderstandings, even with the inspectors, and amongst the consumers has created a feeling of doubt and distrust injurious to the advancement of the meter. In the improved index, the figures are made to revolve instead of the hands; and as the only one figure required on each plate (to denote the number of cubic feet consumed) can be seen at a time, *no mistake can arise*, so that both parties will be satisfied. A reference to the engraving cannot fail to establish its great superiority, and show how the quantity may be read off as 78,900 without the chance of error.

The third improvement is the patent lever valve, B, the object of which is to prevent the numerous complaints of the consumers, and the very heavy losses to the companies, by the lodgment of the old valve, consequent on the corrosion of the guide wires; this lodgment can rarely, if ever, be proved by ocular demonstration, as the slightest movement will cause the valve to fall into its seat, but still it is proved daily, *and beyond all question*, by a diminished registration; and it is not the less objectionable, as an evil, for being a secret and invisible one. The lever valve completely and effectually remedies this; it also indicates a deficiency of water much earlier than the old valve, and the shield protects it at once from any sudden rush of pressure; it may, in fact, be considered perfect in its action, and unassailable on every point.

DRAWING SCALES.

Mr. Drake, of Elm-tree-road, St. John's Wood, land-surveyor, has obtained a patent for making scales for laying down plans, of the same paper as that on which the plan or drawing is laid down. The scales are intended to accompany the plans to which they belong, and being of the same material, they consequently expand or contract, by changes of temperature, in exactly the same proportion as the plan. The paper to be drawn upon is mounted on linen or cotton, by means of India-rubber cement, and, on a strip of it the scale is made. The under surface of the straight edge or holder, by which the scale is held, whilst being used, is rabbetted, and covered with a piece of paper or linen, so as to form a space for the reception of the scale; and the off-set scale, used with it, has a small metal frame at one end, which works against the edge of the holder.

GALVANIZED IRON.

ABOUT five years since a patent was taken out in this country, by M. Sorel, for the purpose of galvanizing iron, by a process of coating it with zinc, in a similar manner to tinning, but for some cause, we believe a dispute among certain capitalists, this patent has been allowed to remain in abeyance, during which period, it has been in considerable use in France, and is, at the present time, we understand, extensively employed by the French government. It is now taken up in this country by some spirited individuals, who have established large works in London for zincing iron to any extent. The process may be applied to both cast and wrought iron in any form.

"The effect of zinc in protecting iron from oxidation," says Professor Graham, "has been known to chemists for some time. When these two metals are in contact, an electrical or galvanic relation is established between them, by which the iron ceases to be susceptible of corrosion by dilute acids, saline solution, or atmospheric humidity. It was found in experiments lately conducted at Dublin and Liverpool, that small pieces of zinc attached to each link of a chain-cable were adequate to defend it from corrosion in sea water. The protection was observed to be complete even in the upper portion of the iron chains by which buoys are moored (and which, from being alternately exposed to sea water and air, is particularly liable to oxidation,) so long as the zinc remained in contact with the iron links. The protecting influence of the zinc could not be more certainly secured than in the articles prepared by the patent process, the iron surface being uniformly coated over by that metal. In trials to which I have had an opportunity of subjecting them, the iron escaped untouched in acid liquids, so long as a particle of the zinc covering remained undissolved. The same protection is afforded to iron in the open atmosphere by zinc, with a loss of its own substance, which is inappreciably minute. The zinc covering has the advantage over tinning, that, although it may be worn off, and the iron below it partially exposed, the iron is still secured from oxidation by the galvanic action, while the smallest quantity of zinc remains upon it; whereas tin, in common tin plate, affords no protection of this kind, and not being absolutely impermeable to air and moisture, the iron under it soon begins to rust in a damp atmosphere. The simplicity and perfect efficacy of the means employed to defend iron from the wasting influence of air and humidity in this process of *zinc tinning*, certainly entitle it to be ranked as one of the most valuable economical discoveries of the present age."

DR PAYERNE'S PATENT FOR PURIFYING AIR.

An abstract of this patent appears in the *Mechanics' Magazine*; it is granted to W. R. Vigers, Esq. of Russell-square, on behalf of Dr. Payerne, "for a mode of keeping the air in confined places in a pure or respirable state, to enable persons to remain or work under water and other places, without a constant supply of fresh atmospheric air."

The first thing claimed and specified is the depriving the atmosphere in confined places of the carbonic acid gas which it contains, produced from respiration or combustion, by means of quick lime and caustic alkali, or of the lime alone, which is to be dissolved in eight times its weight of water. The air in the apartment is to be passed through this caustic solution by a pair of bellows, the nozzle of which reaches nearly to the bottom of the vessel containing the lime and water. The vitiated air thus coming in contact with the lime, the carbonic acid gas is absorbed. It is calculated that one cubic foot of atmospheric air must be purified for each person per minute.

2. The patentee claims the restoring the requisite quantity of oxygen, to supply the place of that consumed; which oxygen is to be procured from the chloride of potash, or driven off from the peroxide of manganese by means of heat, into the apartment or allowed to escape from vessels into which it may have been previously compressed.

3. The patentee claims further, the purification of the air contained in the diving bell, by the process described in claim 1, and the restoring the requisite proportion of oxygen from a vessel attached to the diving-bell, into which the oxygen had been previously compressed; also the allowing the escape of atmospheric air, which had previously been compressed several atmospheres, into two compartments, one of which is situated at each end of a diving bell, somewhat resembling a boat inverted, the centre one being occupied by the diver or workmen, who may, by means of stop-cocks, regulate the supply according to their wants.

The specification is of extraordinary length, filling no less than ten skins of parchment, but the above extract contains all that is material in it.

BITUMINOUS STREET PAVING.

Notwithstanding several unsuccessful trials of bitumen in the paving of carriage-ways, as in the Vauxhall Road some years ago, and more recently in Oxford Street, the Parisian Bitumen Company is at this time engaged in paving the square space opening into Hungerford Market, at the bottom of Hungerford Street, Strand. As this place is not subject to the same kind of wear and tear as a street through which a rapid traffic is constantly passing, it is possible that the bitumen may here answer better than in former trials, and in any case it may interest our readers to know the method pursued by the Company in their present operations.

The bituminous pavement consists of blocks a foot square and 6 inches in depth. These block are composed of an artificial bitumen and angular broken stones, forming a concrete of considerable tenacity. When the granite stones of the old pavement had been taken up and removed, a surface with a considerable convexity in a transverse direction was prepared to receive the bituminous blocks. These are then laid down in straight lines longitudinally, and breaking joint transversely. The blocks are not placed close together, but with a space betwen them of about one inch all round each block. This space is left for the purpose of being filled with melted pitch in order to fix the blocks in their places. These spaces or joints between the blocks are filled in with pitch at several different times; but when the pitch joint is only 2 or 3 in. in depth, the blocks are quite immoveable. When the first thickness of pitch has become quite solid, the joints are filled with the same substance up to the top, and before the top surface of the joint has time to set, a workman sprinkles it over with a sharp, yellow, large grained sea sand, which sets firmly in the pitch. The pavement, when finished, presents the appearance of an ordinary stone pavement, except that the blocks, instead of ranging in straight lines transversely across the road, are placed in straight lines in a longitudinal direction. We can see no good reason for this deviation from the old practice, while on the other hand it has obviously one great defect, namely, that the water falling on the surface is checked in its escape to the sides at every course of stones, and thus the surface of the roadway must be kept constantly wet. The unbroken transverse lines of joints in an ordinary pavement, answer the useful purpose of minute channels to convey the water off to the sides. It may be said that the bituminous surface will prevent the penetration of water, and that the water lodging on the surface is of no consequence. We cannot agree in this, but consider on the other hand that for this very reason bituminous pavement should always be laid with a slope in some direction, so that the water, which can only otherwise escape by evaporating, may drain off it as fast as it falls.

MISCELLANEA.

STOCKTON.—The bridge to substitute the Stockton Suspension Bridge is now in progress; two of the piers are completed—one on each side of the stream; and the gangways and travelling cranes are erected. Mr. Grahamsley of Newcastle is the contractor for the masonry, and Mr. Kitchen of Darlington, the contractor for the iron work. The foundation requires piles 50 feet long, and a 10-horse engine with a ram of 18 cwt., and three men to drive them. The stone piers are dressed in rockwork, six feet broad at top; the span is 83 feet 6 inches between the piers; the roadway is to be carried by cast iron bearers about 3½ feet deep. The site is about 100 feet above the suspension bridge, up the stream or to the west of it. It is not certain whether the suspension bridge will be taken down, or used as a turn-out for empty wagons.

MIDDLESBOROUGH DOCK.—This dock was completed in the early part of 1842, and ships were admitted on the 12th of May in that year, and the shipment of coals has been carried on regularly in the dock since that time. It has an area of nine acres of water surface, and is entered by a commodious channel rather more than a quarter of a mile in length, leading from mid-channel of the river Tees. The entrance lock is 132 feet long, and 30 feet wide; the depth on the sill averages about 18 feet at spring tides, and 15 feet at neap tides; and the coping is 21 feet above the sill. The bottom of the dock is three feet under the level of the sills; the sides of the dock are sloped and paved with stones at the water's edge. For the shipment of coal there are 10 staiths or "drops," at each of which coals may be loaded at the rate of 5 keels, or 105 tons per hour. Ballast is taken out at a very low rate, by means of cranes situated at different places on the river banks. The branch railway leading from the Stockton and Darlington line, which communicates with the dock, is situated on the south side of the town of Middlesborough; it terminates in 10 lines of double railway leading to the 10 drops. The raised platform is covered by three diverging lines of railway, it comprises an area of 15 acres, and affords standage room for 1,200 loaded wagons, or more than 3000 tons of coal, besides ready means of egress for locomotives with their trains of empty wagons. Unfortunately the lock entrance has been constructed too narrow for steam tugs to enter, of which there are about 20 from 25 to 50 horse power. The channel from Middle Tees is very much liable to silt up, and requires constant dredging. Mr. Cubitt was the engineer, and Mr. Turnbull the resident engineer, and Mr. Briggs the contractor.

LOWER SHANNON IMPROVEMENTS, IRELAND.—The works at Banagher are contracted for by Mr. William M'Kenzie, and consist of deepening all the fords in the river from Killalo to Athlone, either by dams and excavating, or by dredging. Two 12 horse dredgers are employed, and two weirs are to be constructed, 1100 feet long each, across the Shannon; also a lock 170 feet by 40 feet, and 8 feet rise to pass an 80-horse steamer; likewise a stone bridge at Banagher of 6 arches 60 feet span, and a 40 feet swivel bridge on one side to pass the steamer through. The works are under government, and are expected to be completed in the ensuing summer.

THE DUKE.—A new steam vessel, of 765 tons burthen, was launched at Liverpool on the 25th of January, having been built by Mr. Thomas Royden for the East India and China trade.

ALEXANDRIA.—We have already informed our readers, says the "*Ecclesiologist*," of our (the Cambridge Camden Society) engagement to supply designs and working drawings of a new church to be erected at Alexandria. These have now been completed by the architect, Mr. Salvin, and will be dispatched by the earliest post to their destination. As it may be interesting to many, and especially to the absent members of the Camden Society, to have some acconnt of the form and plan of this church, we shall here subjoin a brief description of it for their information. The entire length of the church externally is 128 feet by 50 feet in breadth (exclusive of a north and south porch). The plan comprises a full and spacious chancel, 40 feet by 18 feet internally, and a nave and aisles, 78 feet by 40 feet; and a tower with a lofty spire is to be added, if funds can be procured, in the place of the south porch. The chancel is raised by three steps, and is furnished with all the proper appurtenances of stalls, priest's door, credence, sedilia, and piscina. The seats in the nave are ranged in four parallel rows facing the east, there being a passage of 5 ft. 9 in. in the centre, and one of 2 ft. 6 in. in each aisle next to the piers. The seats are, of course, all open. The west front, adapted from that of Llanercost Abbey, exhibits a beautiful façade made by the nave, which is terminated by a high-pitched roof with a gable cross between two large pinnacle turrets, and has below a lofty arcade pierced with two lights, and the two aisles, each of which carries a separate gable with a cross, and a single lancet light. To this front the north porch and southern tower will add great breadth and diversity of effect. The chancel, nave, and aisles will be vaulted; and the clerestory lighted by a circular window in each groined compartment. The aisles are lighted by single lancets between buttresses with pedimented heads and set-offs. The east end will have a peculiarly beautiful effect, from a richly arcaded triplet with a wheel window above, and from the lofty gables of the chancel, nave, and aisles, all of which will he surmounted with crosses, and are similar in design to the west end. The sides of the chancel contain three bays, each of which is arcaded of three, with the central arch pierced for a lancet light. Every portion of this church has been designed in strict conformity with ancient models.

LANCASHIRE.—We have been permitted by the architect, Mr. Sharpe, of Lancaster, a member of our Society, to inspect the plans and working-drawings of a new church which he is now erecting at Knowsley, in Lancashire. There are many points in this design which deserve great commendation, and as a whole, it may safely be pronounced a most successful example of modern church building, although some of the arrangements appear to us liable to serious objection. The church is of the early-English style, and consists of a good chancel, nave with aisles, and tower with broach spire at the west end. There will be no galleries, and the ground-floor alone will accommodate 400 worshippers. There is a well-defined clerestory, supported by beautiful clustered piers and arches, and surmounted by a very fine high-pitched roof, the trusses of which spring from triple-shafted corbels, with floriated capitals. The walls of this church are somewhat too thin to allow of the proper internal splay of the lancets, and appear to us to be too much and too *regularly* pierced. Thus each side of the aisles and clerestory exhibits an equal number of lancets, placed exactly opposite to each other. We should have preferred single lights in both positions, for a church *should be dimly lighted*; or the clerestory might have had foliated circles (a beautiful early-English feature, which we wonder is not more frequently introduced), and the aisles plain two-light windows with circles in the heads. There is too much sameness in so greal a number of lancet windows. The nave roof might have been carried up to the belfry windows with better effect. The tower is very good, and has nothing to which we can object, excepting a number of small trefoil apertures which are intended to light the staircase, but which should rather have been plain oblong slits in the wall. There is, we suspect, but scanty ancient authority for such ornaments, unless in very magnificent towers, and they appear singularly inappropriate when placed just below the point where the broach meets the top of the tower, since this part ought especially to convey the idea of strength and solidity. Small apertures, however, of this description occur in St. Mary's tower, Stamford. The northern porch (we should have much preferred a southern one, or at least a southern door should have been added, as at Woodton, Norfolk; Irnham, Lincolnshire; and of later date, Grantchester and Chesterton churches, near Cambridge,) has too large a doorway, and its roof does not meet that of the aisle in a pleasing manner. The west door would be very good if the mouldings were less meagre and ornamental. A tower doorway of this style should be very deeply recessed, and have a great display of arch moulding. The details in general are very good, and have the rare merit of being at once extremely correct and varied in form. We have several grave objections to make against the internal arrangements. There is no central passage to the altar; but the space which ought to have been left for this purpose is occupied by seats for children. The tables of commandments, creed, &c. are placed in an arcade above the chancel arch—a modernism which we consider altogether inadmissible, to say nothing of its bad effect. We should be inclined to carry the chancel arch considerably higher. The organ is at the east end of the north aisle; it should rather have been at the west, and a window at the east end. The font is too nearly the centre of the nave; its correct position is bythe west pier nearest to the porch. Upon the whole, however, great praise is due to this design; but we deeply regret to observe that some of the internal details are to be executed in *plaster*. We had much rather that they had not been attempted at all. Under the chancel is a vaulted crypt, and above it we observe with no great satisfaction a contrivance for warming the church with hot air.—*Ecclesiologist.*

NEW MILITARY CHURCH AT WINDSOR.—The last stone of the spire of the new military church was laid on Friday morning, Dec. 30. The first stone of this building was laid on the 4th of April last. The church is built of white brick and Bath stone, and its architecture is pure Gothic; it is in the form of a crucifix, having two large transepts for the accommodation of the military and the one at the west end for the children. These galleries are calculated to contain between 400 and 500 persons. A certain portion of the church will be set apart for the accommodation of the soldiers' wives. The body of the church will be fitted up with beautifully carved oaken benches, by which, whilst this arrangement will afford a great number of sittings, will present a light and elegant appearance at a much less cost than the erecting of pews. In addition to the accommodation afforded to the military, there will be about 1,000 sittings for the inhabitants of Windsor and Clewer. The principal feature of this church is the beautiful tower and spire, the tower being nearly 100 feet high, and the spire, of Bath stone, rising 48 feet, surmounted by a vane. The cost of this edifice will be about £10,000, nearly one-half of which is already subscribed, Her Majesty and Prince Albert being large contributors. The building is designed by Mr. E. Blore, and when complete will form a magnificent object from the Castle and surrounding neighbourhood, being one of the most beautiful designs on this side of the metropolis. The whole of the plans have been carried out with great accuracy by Mr. J. B. Heard.

THE PRINCE ALBERT.—A new iron built steamer of the above name, has been making several trips up and down the river Thames, trying her speed, which proves to be very superior, and equal to our fastest steamers; at present she has exceeded the speed of all that she has been able to compete with, even the far famed "Railway." She is an iron built vessel, the deck beams are also of deep angle iron, to which the deck planks are bolted down; her length is 155 ft. between perpendiculars; extreme breadth 19 ft. 6 in.; draught of water when loaded, 4 ft. 6 in.; length of saloon, 36 ft.; fore cabin, 36 ft.; engine room, 26 ft. The engines are of the direct action principle, constructed by Messrs. Braithwaite, Milner, and Co., and are a beautiful specimen of workmanship, and occupy an extremely small space. The diameter of steam cylinders, 40 in.; length of stroke, 40 in.; nominal H.P. of the two engines, 110 horses, with 32 revolutions per minute; diameter of paddle-wheels, 17 ft. 6 in.; breadth, 9 ft.; space occupied by engines, 10 ft. 8 in. in the breadth, and 6 ft. 6 in. in the length of vessel. The engines are constructed with two piston rods to allow the piston in the centre to be hollowed out, that the cover may be dished in a similar manner, to allow the connecting rod and cross-head to descend partially into the cylinder, that the length of connecting rod may be as long as possible, which is equal to three times the radius of crank, or five feet; the air-pump and feed-pump are worked from either end of the cross-head; the boilers are tubular, on *Spiller's* construction. The time occupied in the passage from Blackwall to Gravesend, the day we were on board, was 1 hour 13 minutes, with a slack tide, but against the wind, and 1 hour 5 minutes returning.

TEMPERADOR.—This steam vessel is the first of a pair built for the Post-office service in the Brazils, which business is performed by a private company. She was built by Messrs. Fletcher, Son, and Fearnall, from the designs of Messrs. Ritturden and Carr. (Mr. Ritturden is the surveyor of shipping to the honourable the East India Company.) She is a very superior specimen of Thames building, and her arrangements and cabin fittings are in a style of extreme neatness and comfort. The length between perpendiculars, 151 ft. and over all 169 ft. 6 in.; breadth, extreme to a 3 in plank, 24 ft.; depth in hold, 14 ft.; burthen, old measurement, 418 tons; her draught of water, loaded, is 9 ft. 3 in. forward, and 10 ft. 2 in. aft. She has two engines, of the collective power of 140 horses, constructed by Messrs. Miller, Ravenhill, and Co. They are finished in a superior manner, and work most satisfactorily; the speed of the vessel in the river, with every thing on board, and the coal boxes full, was 10½ statute miles per hour. The vessel left London on the 5th ultimo for South America, and performed the distance from Blackwall to Falmouth Harbour in 42 hours, consuming from 9 to 9½ cwt. of coal per hour, with the steam up to 5¾ inches, and the barometer standing at 27½ inches; the engineer reports that he had plenty of steam, and the firing very easy.

THE BENTINCK.—This fine steam vessel, which has been for some time building as a compamion to the *Hindostan*, was launched on the 26th of January, from the yard of Mr. Wilson, at Liverpool; she is proposed to be nearly a fac-simile of the *Hindostan*, and was moored in the Trafalgar Dock, to be completed, and to receive her engines, which are being constructed by Fawcett and Co.

THE ROYAL MAIL STEAM SHIP "HIBERNIA."—Another superb ship has been added to the fine fleet of steamers belonging to Cunard's line, running between Liverpool and Halifax. She was built at Greenock, by Messrs. Steele and Co.; burthen 1350 tons, length between perpendiculars 218 feet, and depth of hold 24 feet. Her engines were constructed by Mr. Robert Napier of Glasgow, and are of the nominal power, the piston travelling 220 feet per minute, of 550 horses collectively, the diameter of cylinders is 77½ inches, and length of stroke 7 feet 6 inches, the paddle wheels 30 feet 4 inches diameter.

ELECTRIC TELEGRAPH.—Mr. Cook, the joint patentee with Professor Wheatstone, of the voltaic telegraph, has been commissioned to lay down a line from the Paddington station of the Great Western Railway to Windsor Castle, and carry it thence to the Parliament houses and Buckingham Palace. The effect of this will be, that on important occasions, when the sovereign may be at Windsor, any intelligence of extraordinary interest can be transmitted to her Majesty in a second—nay, in less time. The voltaic electricity which governs the motion of the telegraph, travels at the rate of two hundred and eighty-eight thousand miles a second. This has been proved by the delicate instrument invented by Professor Wheatstone. The new and m st singular arrangement will be of great value in connection with the public service. When cabinet councils sit on momentous questions, her Majesty can be acquainted with the result of their deliberations as instantaneously as if she were present. When the Queen presides over the meetings of her ministers in person at Windsor, it not unfrequently happens that information on a particular subject may be required from the departments in London; and hitherto, when this has been the case, it of course became necessary to send an express to town to obtain what was called for, before the business could satisfactorily proceed. Now it, in most cases, will be procured while the council is sitting, and, indeed, in the course of four or five minutes, which before would have caused a delay of as many hours. This will not only be of use on great occasions, but in a common way its every-day value will be considerable. During the session of parliament, for instance, on every question of interest her Majesty can learn the division, or the progress made in a debate, one moment after the house has divided, or any particular orator has risen to speak or resumed his seat. Thus, a more rapid communication between the sovereign and her ministers for the time being will be established than has ever been known or thought of before.—*Mirror.*

THE BIRMINGHAM TOWN HALL ORGAN has undergone great alterations. These consist of certain new arrangements and adaptations, founded on an extensive survey of the great organs both in Germany and Holland; and will have the effect of greatly increasing the powerfulness, and variety of this splendid instrument, the recent improvements having caused an addition of about 1200 pipes. The height of the case is 54 feet, and 40 feet wide, and, contains about 4000 pipes. The circumference of the CCCC metal pipe is 5 feet 3 inches; the largest wood pipe (the CCCC) is 12 feet in circumference, and its interior measurement is 224 cubic feet. The organ contains 63 real stops, six copulas, and has four sets of keys; the fourth is the combination or solo organ, upon which (by an ingenious contrivance) can be played any stop or stops out of the swell or choir, without interfering with their previous arrangement. There are several stops peculiar to this organ, and which are not to be found in any other; amongst them is the grand ophicleide, invented by Mr. Hill, which is distinguished by its immense power and richness of tone. The posaune is built on a large scale, and is by far the most powerful ever made. By coupling the pedals with the keys, 87 pipes are made to speak with each pedal. The bellows contain 300 square feet of surface, and upwards of 3 tons weight upon them is required to give the necessary pressure. The machinery of the organ is so very extensive, that the trackers, if placed in one line, would measure more than 5 miles.

NANKIN AND ITS PORCELAIN WORKS.—Numerous, as you may conceive, have been the pilgrimages made to the far-famed "Porcelain Tower," for the first time in inspecting any of the monuments *rénommés* of this country, no disappointment has been experienced, while comparing what actually is, with what the legends of the book-makers in China describe to be. It is, indeed, a most elegant and singular structure, as remarkable for its correct proportions as for the rare material of which it is partially composed. I say partially, because the mass of building is not of porcelain, but is composed of common brick, with a facing and lining of beautiful white glazed porcelain bricks or slabs, fixed into the masonry by means of deep keys or shoulders, cast like a half T, on the brick. Its form is octagonal, and running up each of the angles is a moulding of large tiles of very fine clay, glazed and coloured red and green alternately; round each story runs a high balustrade formed of green porcelain, upon which four arched doorways open, set to the four cardinal points, the arches being elegantly turned with large glazed tiles, cast in all imaginable fancies of design and variegation of colour representing wild beasts, demons, deities, monsters, &c. It appears to be a "sight" amongst the Chinese themselves, for there are priests or bonzes attached to the building to keep it in order, who earn their consideration by distributing to the visitors lithographed elevations of the tower, with descriptions attached, and who seem to have the duty entrusted to them of illuminating it on gala occasions. This is effected by means of lanterns made of thin oyster shells, used in lieu of window glass by the Chinese, which are placed at each of the eight angles on every story, and the effect of whose subdued light on the highly reflective surface of the tower must be most striking and beautiful.—*Bombay Spectator.*

FLORENCE.—*The Duomo.*—The grand Duke has given orders that the "Gran Duomo" of Florence shall be completed under the direction of the Imperial Academy. The dome was begun to be built in 1296, by Arnolfo di Lapo. In the works now to be commenced, the materials to be employed are marbles from the quarries of the two mountains Seravezza and Altissimo, in some respects more beautiful than those of Carrara, and they are those which Michael Angelo made use of.

THE VARIATION OF THE COMPASS.

Observations made at the Royal Observatory, Greenwich,

G. B. AIRY, Astronomer Royal.

Mean Magnetic		Declination.	Dip at 9 A.M.	Dip at 3 P.M.
		° ′ ″	° ″	° ′
1842	October	23 18 4		
	November ..	23 17 22	68 56½	69 0¼
	December ..	23 17 22	68 56	68 59½

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM JANUARY 31, TO FEBRUARY 25, 1843.

Six Months allowed for Enrolment, unless otherwise expressed.

George Benjamin Thorneycroft, of Wolverhampton, ironmaster, for "*improvements in furnaces used for the manufacture of iron, and also in the mode of manufacturing iron.*"—Sealed Jan. 31.

William Maugham, of Newport-street, Lambeth, chemist, for "*an improvement in preparing aerated water.*"—Jan. 31.

William Barnard Boddy, of Saint Mary, Newington, surgeon, for "*improvements in apparatus and means for opening, shutting, and fastening every description of sliding and lifting window sashes, windows, and window shutters.*"—Jan. 31.

William Robinson Shaw, of Leeds, engineer, for "*improvements in feeding or supplying steam boilers with water.*"—Jan. 31.

Samuel Kirk, of Staly-bridge, Lancaster, cotton spinner, for "*improvements in machinery or apparatus for preparing cotton and other fibrous substances for spinning.*"—Jan. 31.

Charles Hancock, of Grosvenor-place, artist, for "*an improved means of dyeing or staining cotton, woollen, silk, and other fabrics, and rendering them repellent of waters and moisture.*"—Jan. 31.

Charles Clark, of Great Winchester-street, London, merchant, for an "*improved pyro-hydro pneumatic apparatus, or means of generating, purifying, and condensing steam and other vapours, and of extracting from vegetable substances the soluble portions thereof, as also the application of parts of the said apparatus to other heating, evaporating and distilling purposes.*"—Jan. 31.

James Clark, of Glasgow, power-loom cloth manufacturer, for "*an improved mode of manufacturing certain descriptions of cloths.*"—Feb. 1.

John Hill, of Manchester, machine-maker, for "*improvements in or applicable to looms for weaving carpets and various other fabrics in which raised loops or a raised pile constitute the face or the figure of the fabric.*"—Feb. 11.

Robert Hicks, of Old Burlington-street, surgeon, for "*improvements in apparatus for impregnating liquids with gases.*"—Feb. 11.

Joseph Morgan, of Manchester, manufacturer of patent candle-making machines, for "*improvements in the manufacture of candles.*"—Feb. 11.

Jonathan Badger, of Sheffield, carpenter and builder, for "*improvements in the construction of bedsteads for invalids.*"—Feb. 11.

Christopher Nickels, of York-road, Lambeth, gentleman, for "*improvements in the manufacture of fabrics made by lace machinery.*"—Feb. 11.

Thomas Ensor, of Milborne Port, glove manufacturer, for "*improvements in the manufacture of leather gloves.*"—Feb. 11.

Henry Du Bochet, of South Mall, Ireland, piano-forte tuner, for "*a new method of making pianofortes.*"—Feb. 11.

Thomas Wolverstan, of Salisbury, iron founder, for "*improvements in axletrees and axletree boxes.*"—Feb. 11.

Alfred Brewer, of Surrey-place, Old Kent-road, wire-weaver and felt manufacturer, for "*improvements in machinery for manufacturing paper.*" (A communication.)—Feb. 11.

George Ebenezer Doudney and Edward Phillips Doudney, of Mile-end, Portsea, candle manufacturers, for "*improvements in the manufacture of dip and mould candles.*"—Feb. 17.

James Boydell, jun., of Oak Farm Iron Works, near Dudley, ironmaster, for "*improvements in apparatus for retaining the wheels of carriages in the event of an axis breaking, or otherwise.*"—Feb. 17.

Henry Ross, of Leicester, worsted manufacturer, for "*improvements in combing and drawing wool, and other fibrous substances.*"—Feb. 17.

Charles Brook, of Meltham Mills, York, cotton spinner, for "*improvements in the apparatus used for purifying gas.*"—Feb. 17.

William Newton, of Chancery-lane, civil engineer, for "*an improved system of working coal mines and quarries of stone, marble, and slate, which may also be applied to the making of tunnel borings, or to other purposes of the like kind.*" (A communication.)—Feb. 20.

John Kymer, of Pontardalaw, South Wales, coal proprietor, and Thomas Hodgson Leighton, of Llanelly, Carmarthen, chemist, for "*improvements applicable to the burning anthracite or stone coal, and other fuel, for the purpose of obtaining heat.*"—Feb. 21.

Joseph Crannis and Robert Kemp, both of Southwark, furriers, for "*improvements in wood paving.*"—Feb. 21.

Benjamin Brunton Blackwell, of Newcastle-upon-Tyne, gentleman, and William Norris, of the city of Exeter, civil engineer, for "*an improvement in coating iron nails, screws, nuts, bolts, and other articles made of iron with certain other metals.*"—Feb. 21.

Lawrence Holker Potts, of Greenwich, doctor of medicine, for "*new or improved methods of conveying goods, passengers, or intelligence.*"—Feb. 21.

Henry Clarke, of Drogheda, linen merchant, for "*improvements in machinery for lapping and folding all descriptions of woven textures and surface fabrics.*"—Feb. 23.

Francis Roubiliac Conder, of Highgate, Middlesex, engineer, for "*improvements in the cutting and shaping of wood, and in the machinery for that purpose.*" (A communication.)—Feb. 23.

JOHN HAGGERSTON LEATHES, of Norwich, gentleman, and WILLIAM KIRRAGE, of the same place, asphalte manufacturer, for "*improvements in coffins.*"—Feb. 25,